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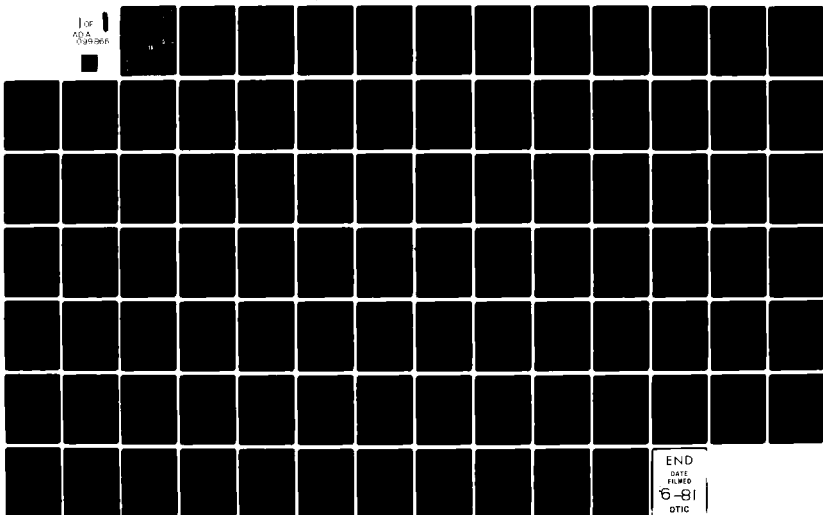
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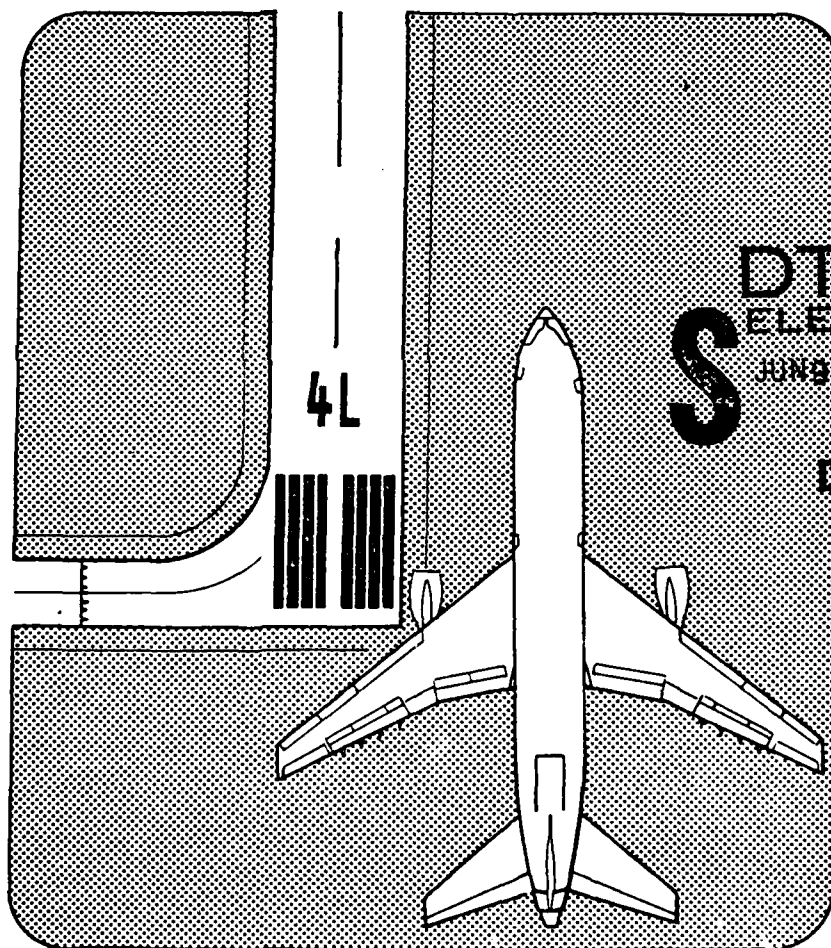
16. **LEVEL III**
NEW YORK AIRPORTS

DATA PACKAGE NO. 3

**JOHN F. KENNEDY INTERNATIONAL AIRPORT,
LA GUARDIA AIRPORT.**

**AIRPORT IMPROVEMENT
TASK FORCE DELAY STUDIES.**

AD A099866



prepared for
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
under contract

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SAN FRANCISCO INTERNATIONAL AIRPORT

SAN FRANCISCO, CALIFORNIA 94128

Telephone: (415) 347-9521

October 12, 1978

Mr. Ray H. Fowler, AEM-100
U.S. Department of Transportation
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

Re: New York Data Package No. 3

Dear Ray:

Enclosed is preliminary Data Package No. 3 for John F. Kennedy International (JFK) and LaGuardia (LGA) Airports for use during the fourth New York Task Force Meeting on October 17, 1978. Attachment A contains the results of the JFK Stage I Experiments; Attachment B has the results of the LGA Stage-1 Experiments.

These attachments should be reviewed and approved by the New York Task Force at their fourth meeting on October 17. The Stage-2 experiments for JFK and LGA should also be defined at that meeting.

Sincerely,

[Signature]
for Stephen L. M. Hockaday
Manager

SLMH/nbe
Enclosures

cc: Mr. J. R. Dupree, ALG-312
Mr. C. Caifa, AEA-4

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Attachment A

RESULTS OF STAGE-1 DELAY EXPERIMENTS

John F. Kennedy International Airport

New York
Airport Improvement Task Force Delay Studies

Peat, Marwick, Mitchell & Co.
San Francisco, California

October 1978

TABLE A-1
KENNEDY DELAY EXPERIMENTS

Experiment Number	Model	Study Case ^a	Arrival Runways	Departure Runways	Weather	Demand	ATC System Scenario	Near-Term Improvements
Stage I Experiments								
1	ASM ^c	1	13R, 22L, 22R	VFR1	1977	Today's		None ^d
2	ASM	2	22L	22R	IFR1	1977	Today's	None
2A	ASM	2	22L	22R	IFR1	1977	Today's	None
3	ASM	4	4L, 4R	4L	VFR1	1977	Today's	None
4	ASM	5	4R	4L	IFR1	1977	Today's	None
5	ASM	7	31L, 31R	31L	VFR1	1977	Today's	None
6	ASM	8	31R	31L	IFR1	1977	Today's	None
7	ASM	10	13L, 13R	13R	VFR1	1977	Today's	None
8	ASM	11	13L	13R	IFR1	1977	Today's	None
9	ADM	n.a. ^f	n.a.	n.a.	n.a.	1977	Today's	None
15	ASM	8	31L, 31R	31L, 31R	IFR1	1977	Today's	None ^g
16	ASM	7	31L, 31R	31L, 31R	VFR1	1977	Today's	h
18	ASM	5	4L, 4R	4L	IFR1	1977	Today's	i
19	ASM	2	22L	22R	IFR1	1977	Today's	j

a. Study cases (combinations of runway use and weather conditions) and potential near-term improvements are identified in New York Airport Improvement Task Force Interim Report. The study cases are shown in Figure III-1. The potential improvements are identified in Appendix B.

b. FAA will describe impact of post-1982 ATC systems on model inputs.

c. Airfield Simulation Model.

d. Task Force will establish packages of near-term improvements most likely to be implemented in pre-1982 and post-1982 time frames.

f. Not applicable (model considers annual occurrence of each study case).

g. Has procedure for independent arrivals and independent departures on 31L and 31R.

h. Has independent departure tracks R31L and R31R.

i. Permits 2 miles staggered arrival separation 4R and 4L.

j. Extends parallel taxiway to runway and 31L and adds a new turnoff to R22L.

k. Turnoff J on Runway 22L is assumed closed.

TABLE A-2
JFK
INDEX OF STAGE-1 EXPERIMENT RESULTS

<u>Sequence No.</u>	<u>Experiment No.</u>	<u>Study Case No.</u>	<u>Model</u>	<u>Page</u>
1	1	1	ASM	5
2	2	2	ASM	8
3	2A	2	ASM	11
4	19	2	ASM	14
5	3	4	ASM	17
6	4	5	ASM	20
7	18	5	ASM	23
8	5	7	ASM	26
9	16	7	ASM	29
10	6	8	ASM	32
11	15	8	ASM	35
12	7	10	ASM	38
13	8	11	ASM	41
14	9		ADM	

*Stage 1 experiments as presented in revised Table A-1 but reorganized and grouped by like runway-use configurations to facilitate comparisons.

Table A-3

NEW YORK TASK FORCE DELAY STUDIES
John F. Kennedy International Airport
Summary Results of Stage-1 Experiments
Airfield Simulation Model Runs

Experiment No.	Runways Used		Time Frame	Weather Conditions	Average Flow Rates			Average Runway Delays			Average Taxiing Delays			Major Comparison Case			
	Arrivals	Departures			Arrivals	Departures	Arrival Air	Departures	Taxi-In	Taxi-Out							
1	13R, 22L, 22R	22R	1977	VFR1	47	17-18	38	20-21	16.6	20:15	27.0	20:30	11.4	21:15	0.4	20:15	baseline 2
2	22L	22R	1977	IFR1	29	18-19	36	19-20	192.1	22:15	12.3	19:15	1.1	19:15	0.4	19:30	baseline 1, 2A, 19
2A	22L	22R	1977	IFR1	29	18-19	37	19-20	193.7	22:15	12.7	19:15	0.7	19:15	0.4	19:30	2, 19
19	22L	22R	1977	IFR1	29	18-19	37	19-20	198.9	22:15	12.3	19:15	1.3	19:15	0.4	19:30	2, 2A
3	4L, 4R	4L	1977	VFR1	40	17-18	33	20-21	92.0	22:00	38.4	20:45	8.2	21:30	1.9	22:15	baseline 4
4	4R	4L	1977	IFR1	26	18-19	36	19-20	201.3	22:15	13.2	19:15	0.2	many	0.3	many	baseline 3
18	4L, 4R	4L	1977	IFR1	34	17-18	36	21-22	138.8	22:30	26.8	20:30	2.1	20:15	0.3	many	4
5	31L, 31R	31L, 31R	1977	VFR1	49	17-18	41	19-20	5.2	16:30	12.8	19:15	0.5	20:00	0.5	19:00	baseline 16, 6
16	31L, 31R	31L, 31R	1977	VFR1	50	17-18	43	19-20	3.2	16:30	3.0	19:00	1.0	20:00	0.5	19:00	5
6	31R	31L	1977	IFR1	29	17-18	41	19-20	151.7	22:30	11.4	19:15	0.2	many	0.3	many	baseline 15, 5
15	31L, 31R	31L, 31R	1977	IFR1	49	17-18	43	19-20	6.4	16:30	3.2	19:00	1.0	20:00	0.6	19:00	6
7	13L, 13R	13R	1977	VFR1	49	17-18	40	19-20	3.0	16:30	0.6	many	15.3	19:30	0.6	many	baseline 8
8	13L	13R	1977	IFR1	29	17-18	40	19-20	153.8	22:30	9.5	19:15	0.5	18:30	0.3	19:00	baseline 7

JFK - STAGE 1Experiment No. 1Objective:

To obtain baseline delay estimates for the following runway configuration in VFR 1:

<u>Arrival Runways</u>	<u>Departure Runways</u>
------------------------	--------------------------

13R, 22L, 22R	22R
---------------	-----

Related Comparison Experiments:

Experiments 2, 2A, and 19 have similar runway-use configurations but different weather conditions, namely IFR1 instead of VFR 1.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 1A shows that total aircraft vary from 16 to 75 aircraft per hour over the 8-hour simulation run. The peak hour is from 17:00 to 18:00 hours and contained 47 arrivals and 28 departures. Figures 1A and 1B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 21 aircraft per hour, which is 28 percent of the corresponding peak-hour total flow rate.

Figure 1B shows that average delays by 15-minute interval to aircraft using the runways are as high as 27.0 minutes per aircraft. Peak hour average delays* are 16.6 minutes for arrivals and 27.0 minutes for departures.

Figure 1C shows that the peak-period average delays to aircraft using the taxiways are 11.4 minutes for taxi-in and 4.0 minutes for taxi-out.

Figure 1D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

*Peak hour average delays quoted in all experiments refer to the peak 15-minute interval.

FIGURE 1A AVERAGE RUNWAY FLOW RATES

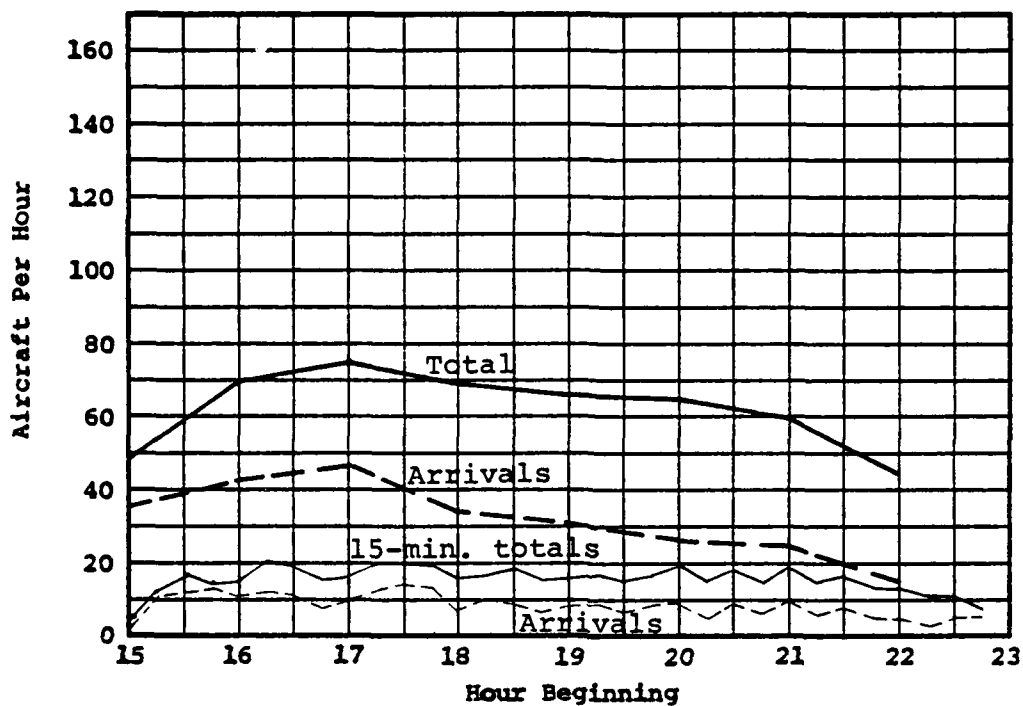


FIGURE 1B AVERAGE RUNWAY DELAYS

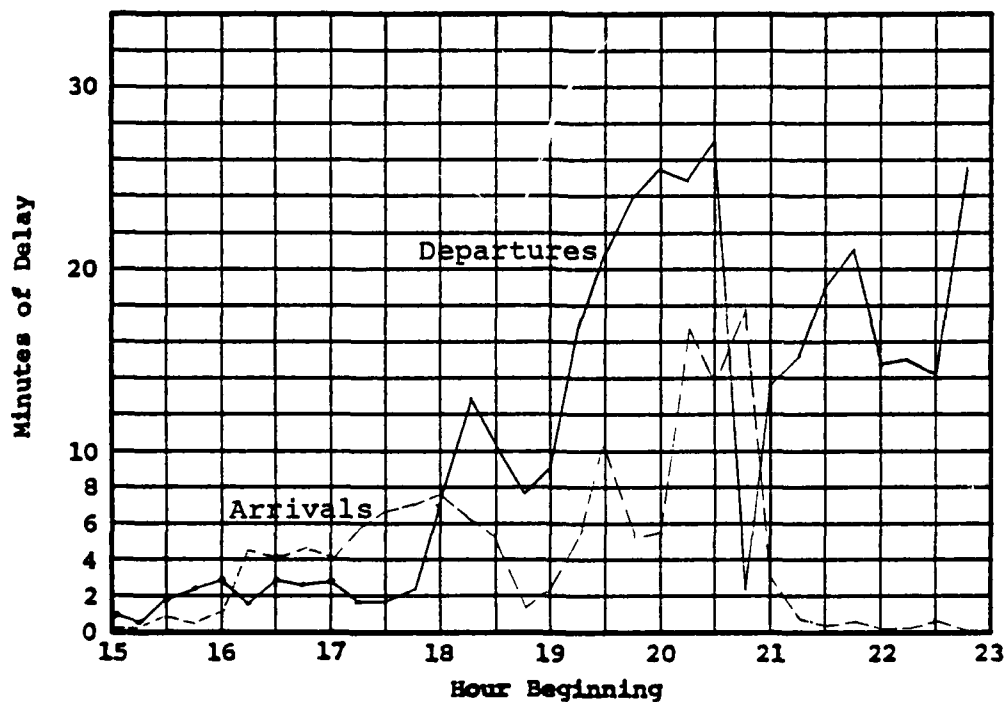


FIGURE 1C AVERAGE TAXIWAY DELAYS

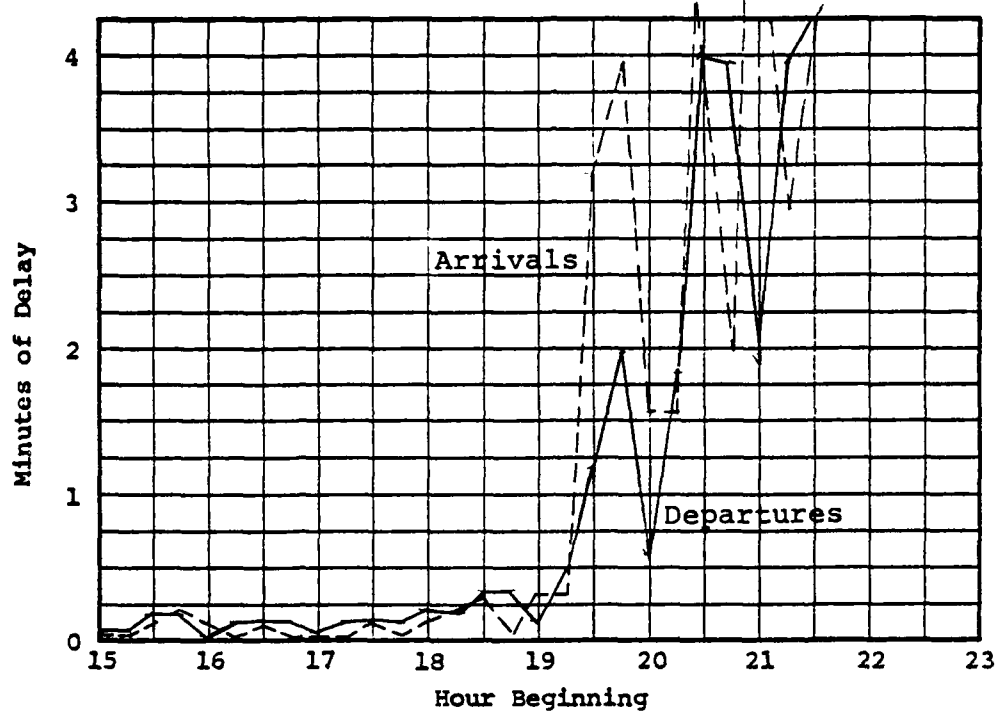
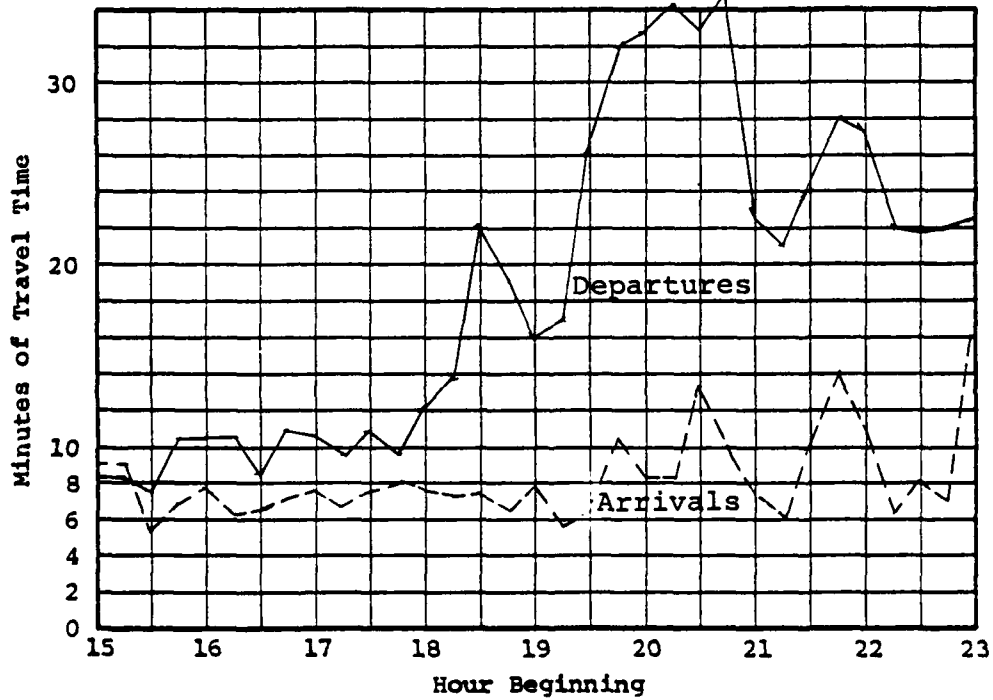


FIGURE 1D AVERAGE TAXIWAY TRAVEL TIMES



JFK - STAGE 1Experiment No. 2Objective:

To obtain baseline delay estimates for the following runway-use configuration in IFR1:

<u>Arrival Runways</u>	<u>Departure Runways</u>
22L	22R

Related Comparison Experiments:

Experiments 2A and 19 are for the same runway-use configuration and weather, but for different exit taxiway arrangements.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 2A shows that total aircraft flows vary from 32 to 59 aircraft per hour over the 8-hour simulation run. The peak hour is from 21:00 to 22:00 hours and contained 24 arrivals and 35 departures. Figures 2A and 2B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 17 aircraft per hour, which is 29 percent of the corresponding peak-hour total flow rate.

Figure 2B shows that average delays by 15-minute interval to aircraft using the runways are as high as 192.1 minutes per aircraft. Peak hour average delays are 192.1 minutes for arrivals and 12.3 minutes for departures.

Figure 2C shows that the peak-period average delays to aircraft using the taxiways are 1.1 minutes for taxi-in and 0.4 minutes for taxi-out.

Figure 2D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 2A AVERAGE RUNWAY FLOW RATES

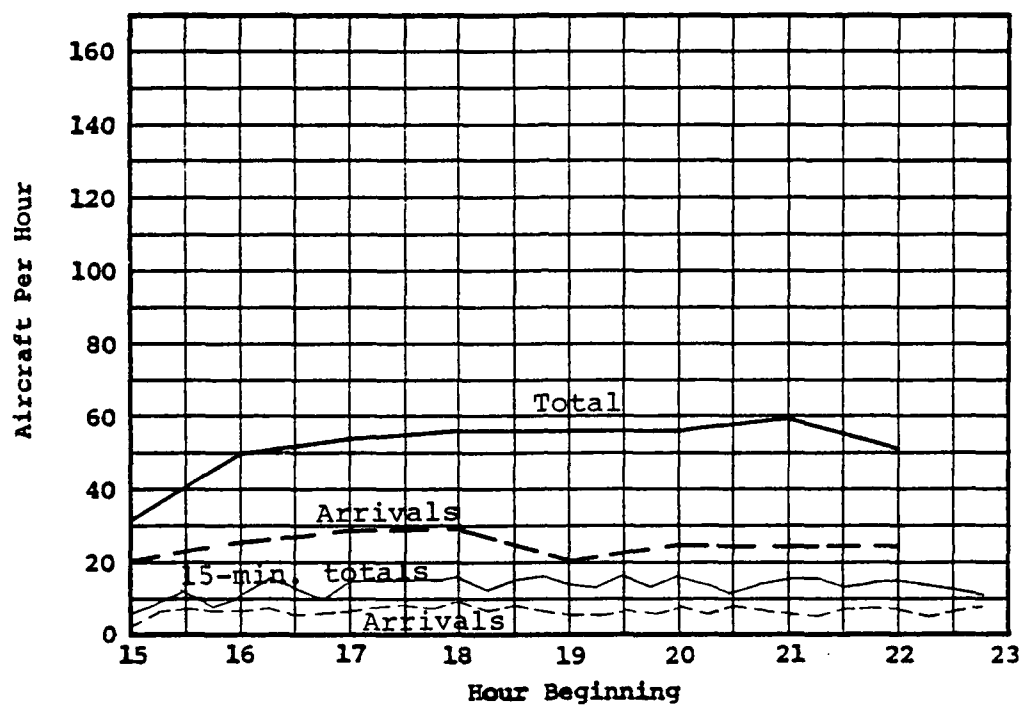


FIGURE 2B AVERAGE RUNWAY DELAYS

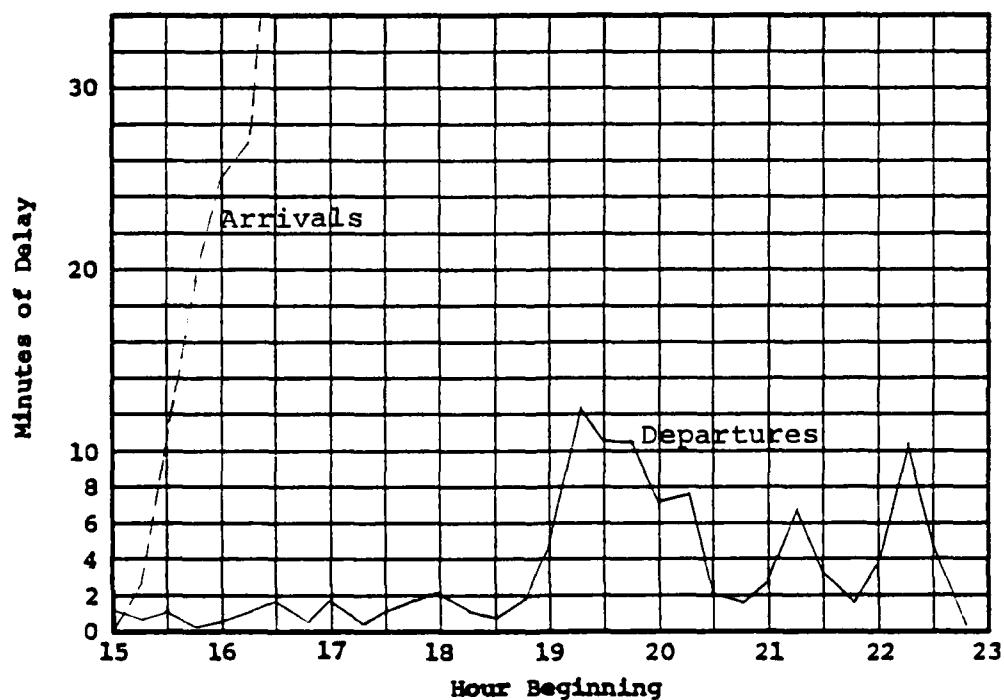


FIGURE 2C AVERAGE TAXIWAY DELAYS

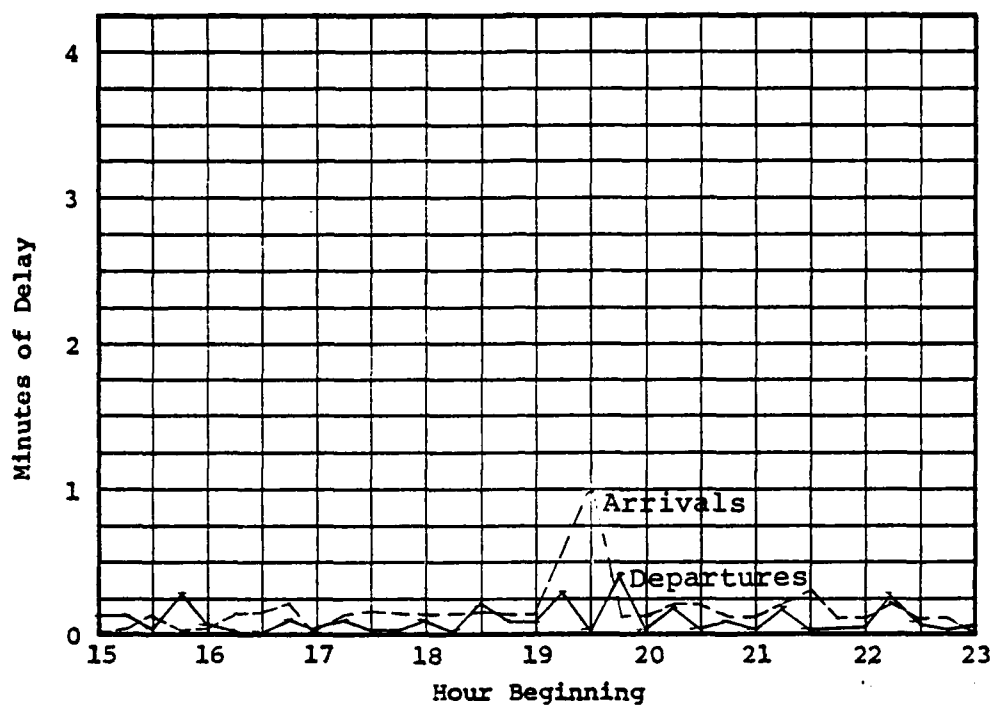
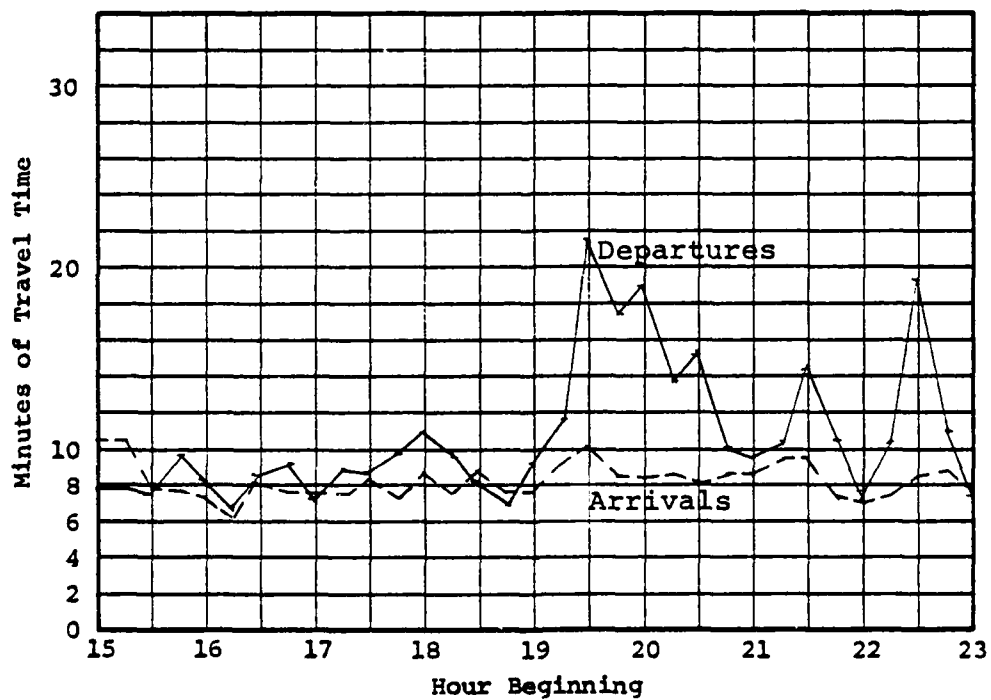


FIGURE 2D AVERAGE TAXIWAY TRAVEL TIMES



JFK - STAGE 1Experiment No. 2AObjective:

To provide baseline comparison delay estimates for the situation where exit taxiway J from arrival runway 22L is closed and aircraft that miss exit H must exit at the end of the runway.

Related Comparison Experiments:

Experiment 19 provides the case where a new exit (between J and H) is provided from Runway 22.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Anticipated Results:

Lower arrival capacity and greater arrival delays than in Experiment 2.

Results:

Figures 2A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment Peak</u>	<u>Time</u>	<u>Experiment No. 2 Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	29	18-19	29	18-19
Arrival	Runway Delay	min.	193.7	22:15	192.1	22:15
Arrival	Taxi-In Time	min.	10.5	15:00	10.3	15:00
Departure	Flow Rate	a/c per hr.	37	19-20	36	19-20
Departure	Runway Delay	min.	12.7	19:15	12.3	19:15
Departure	Taxi-Out Delay	min.	0.4	19:30	0.4	19:30

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE (2A) A AVERAGE RUNWAY FLOW RATES

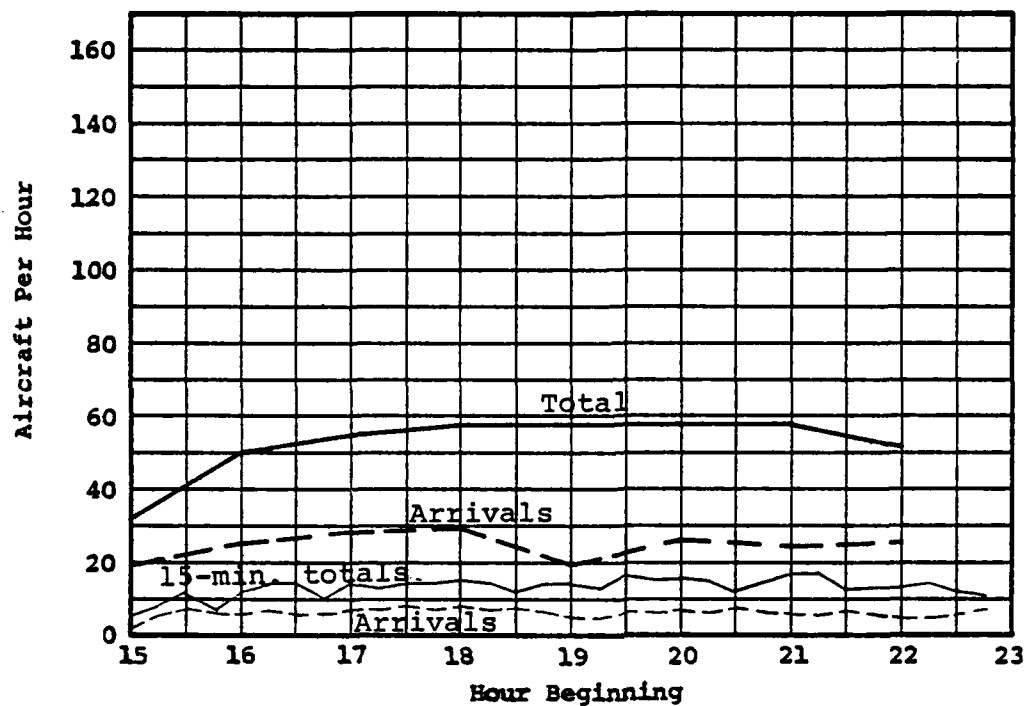


FIGURE (2A) B AVERAGE RUNWAY DELAYS

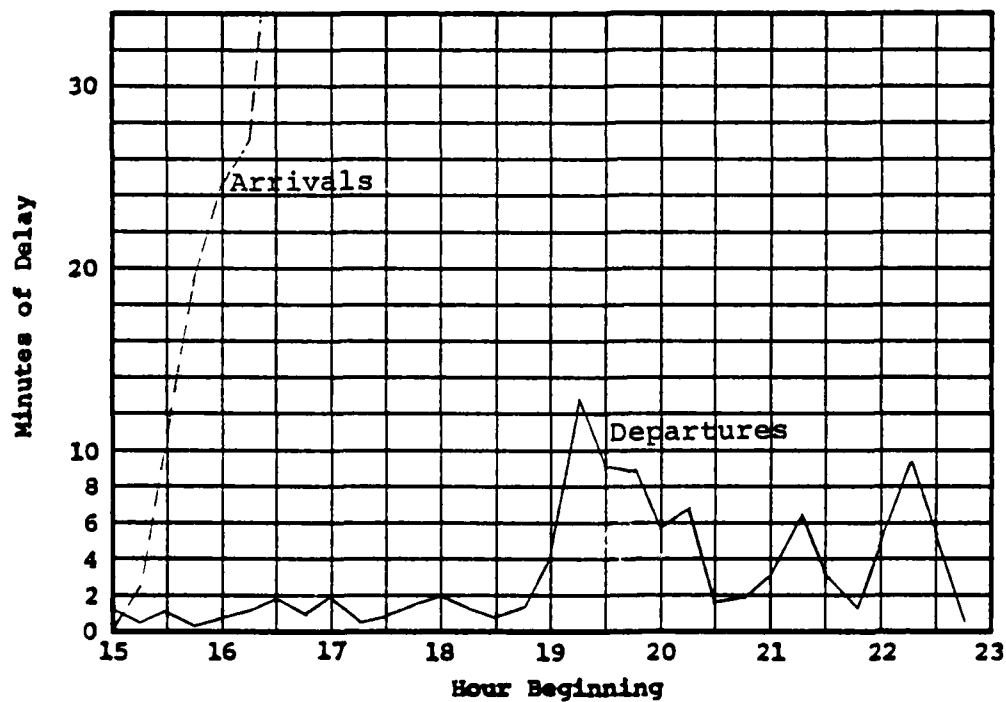


FIGURE (2A)C AVERAGE TAXIWAY DELAYS

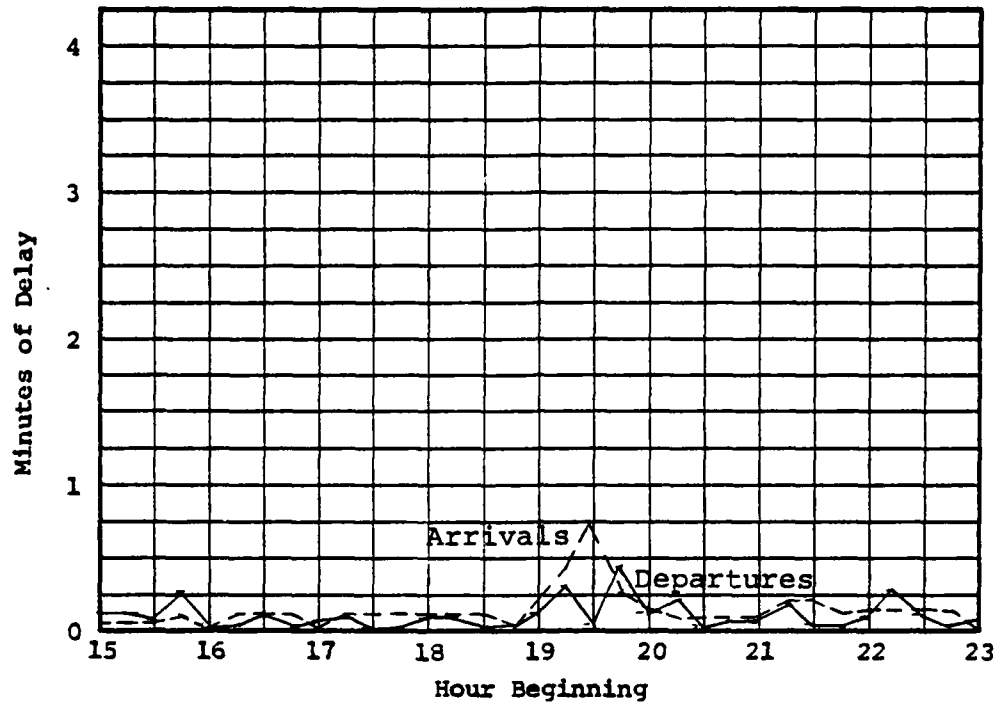
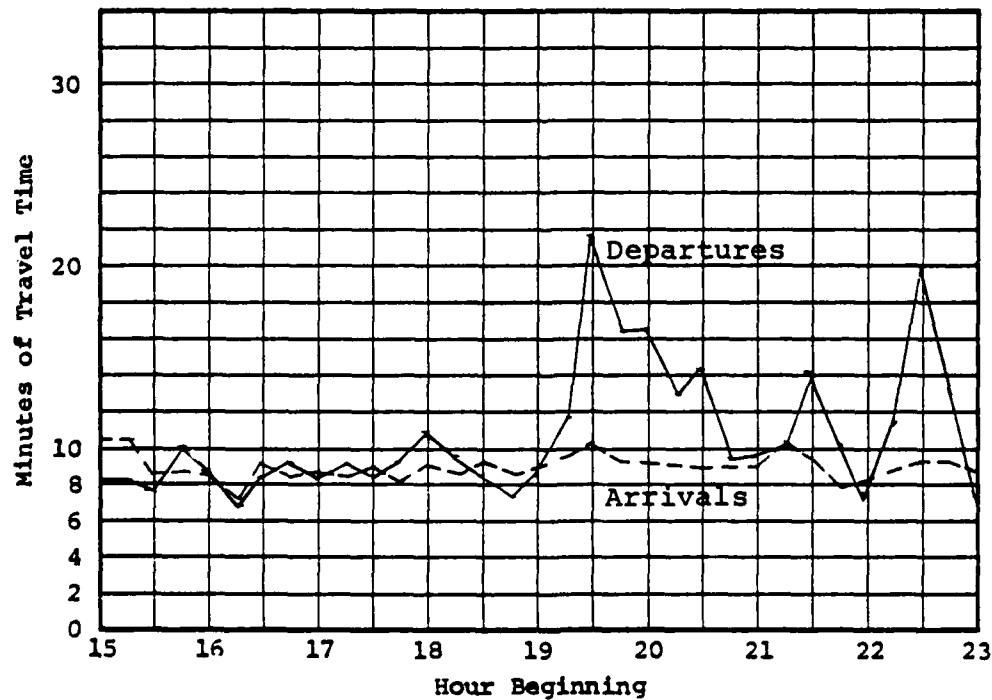


FIGURE (2A)D AVERAGE TAXIWAY TRAVEL TIMES



JFK - STAGE 1Experiment No. 19Objective:

To investigate potential benefits of adding an additional turnoff runway 22L between exits H and J.

<u>Arrival Runways</u>	<u>Departure Runways</u>
------------------------	--------------------------

22L

22R

Related Comparison Experiments:

Experiments 2 and 2A.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Anticipated Results:

Lower arrival capacities and greater arrival delays than Experiment No. 2. Lower arrival delays than Experiment 2A.

Results:

Figures 19A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment</u>		<u>Experiment No. 2</u>	
			<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	29	18-19	29	18-19
Arrival	Runway Delay	min.	198.9	22:15	192.1	22:15
Arrival	Taxi-In Time	min.	10.0	15:00	10.3	15:00
Departure	Flow Rate	a/c per hr.	37	19-20	36	19-20
Departure	Runway Delay	min.	12.3	19:15	12.3	19:15
Departure	Taxi-Out Delay	min.	0.4	19:30	0.4	19:30

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 19A AVERAGE RUNWAY FLOW RATES

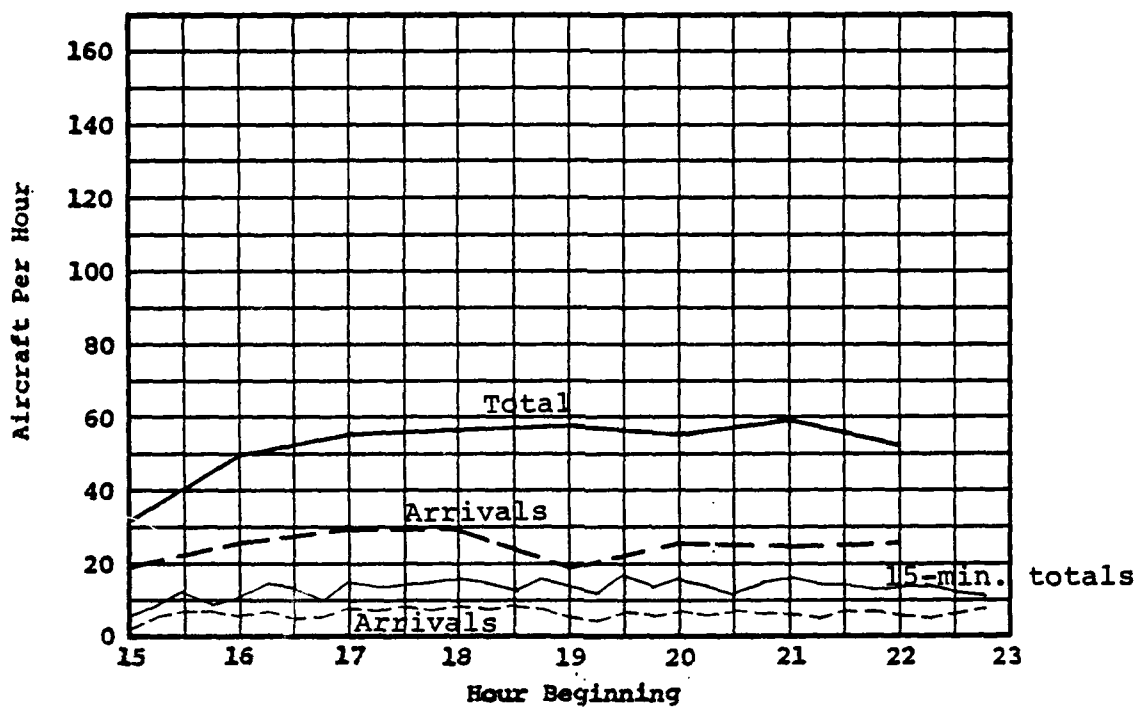


FIGURE 19B AVERAGE RUNWAY DELAYS

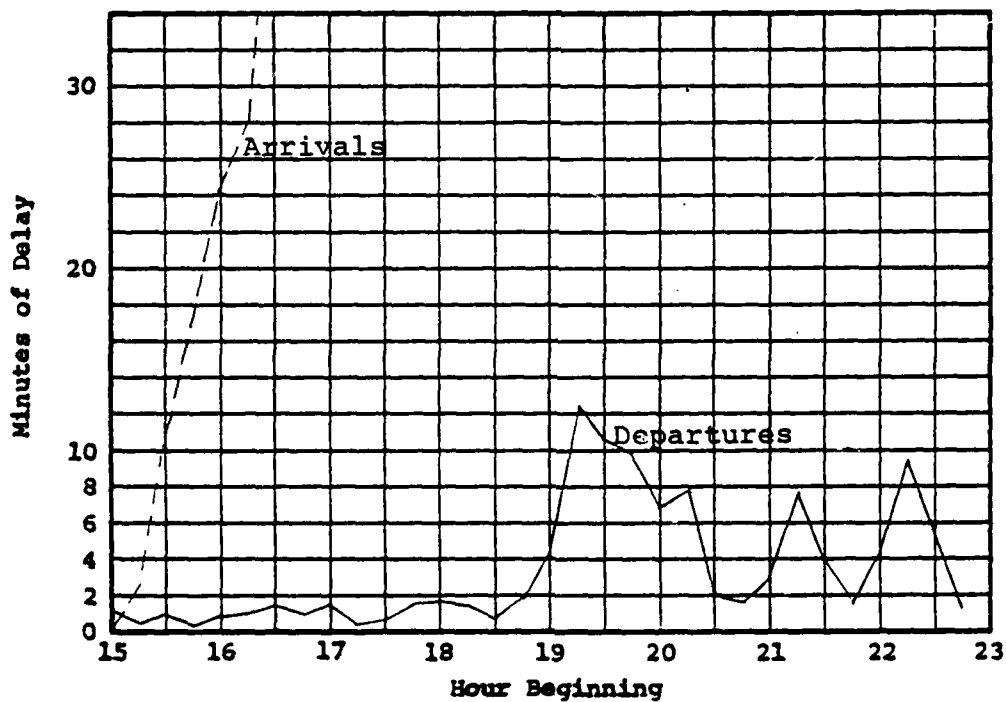


FIGURE 19C AVERAGE TAXIWAY DELAYS

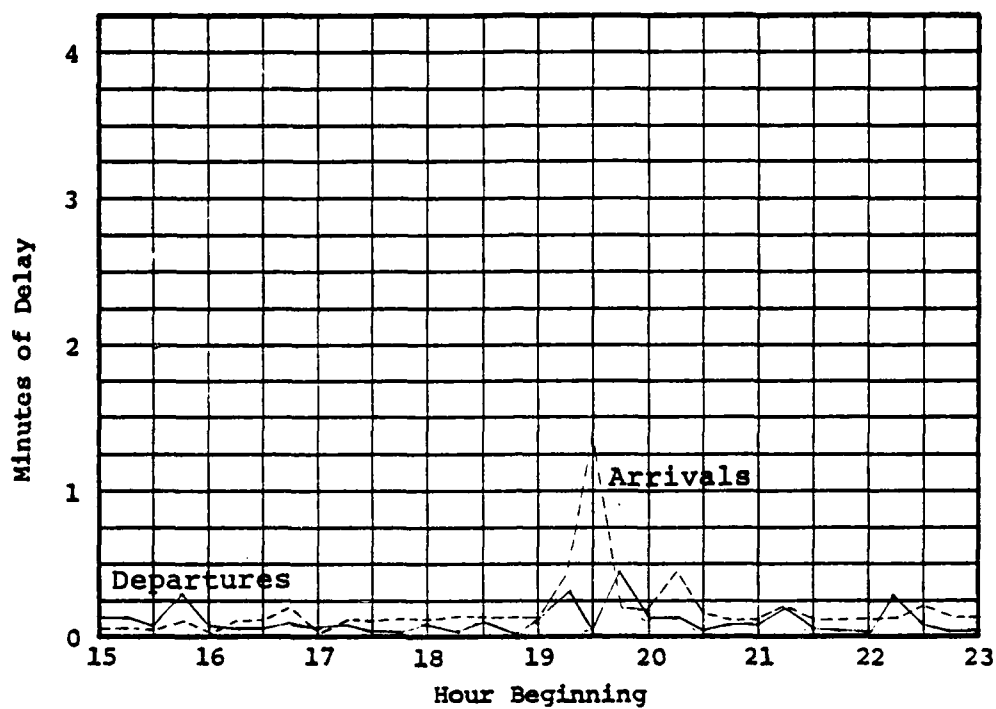
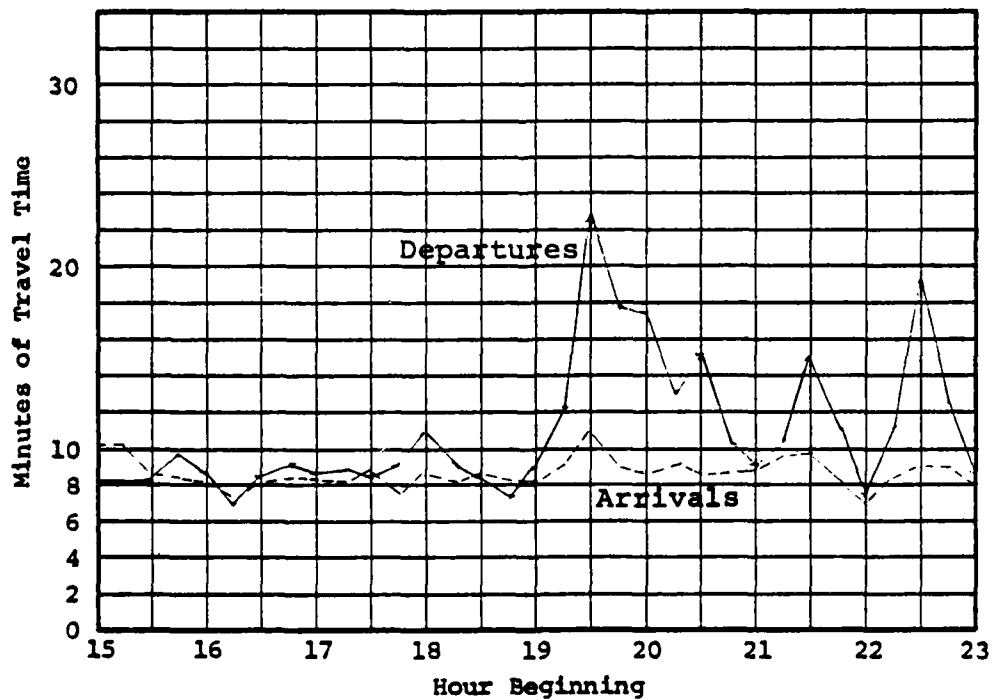


FIGURE 19D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE-1 EXPERIMENTS

Experiment No. 3

Objective:

To obtain baseline delay estimates in VFR1 conditions for the following runway-use configuration:

<u>Arrival Runways</u>	<u>Departure Runways</u>
4L, 4R	4L

Related Comparison Experiments:

Experiment 4 has the same basic runway-use configuration without arrivals on 4L, and Experiment 18 has the same configuration but with 2-mile staggered arrival separations on 4R and 4L.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 3A shows that total aircraft flows vary from 44 to 70 aircraft per hour over the 8-hour simulation run. The peak hour is from 17:00 to 18:00 hours and contained 40 arrivals and 30 departures. Figures 3A and 3B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 20 aircraft per hour, which is 29 percent of the corresponding peak-hour total flow rate.

Figure 3B shows that average delays by 15-minute intervals to aircraft using the runways are as high as 92.0 minutes per aircraft. Peak hour average delays are 92.0 minutes for arrivals and 38.4 minutes for departures.

Figure 3C shows that the peak-period average delays to aircraft using the taxiways are 8.2 minutes for taxi-in and 1.9 minutes for taxi-out.

Figure 3D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 3A AVERAGE RUNWAY FLOW RATES

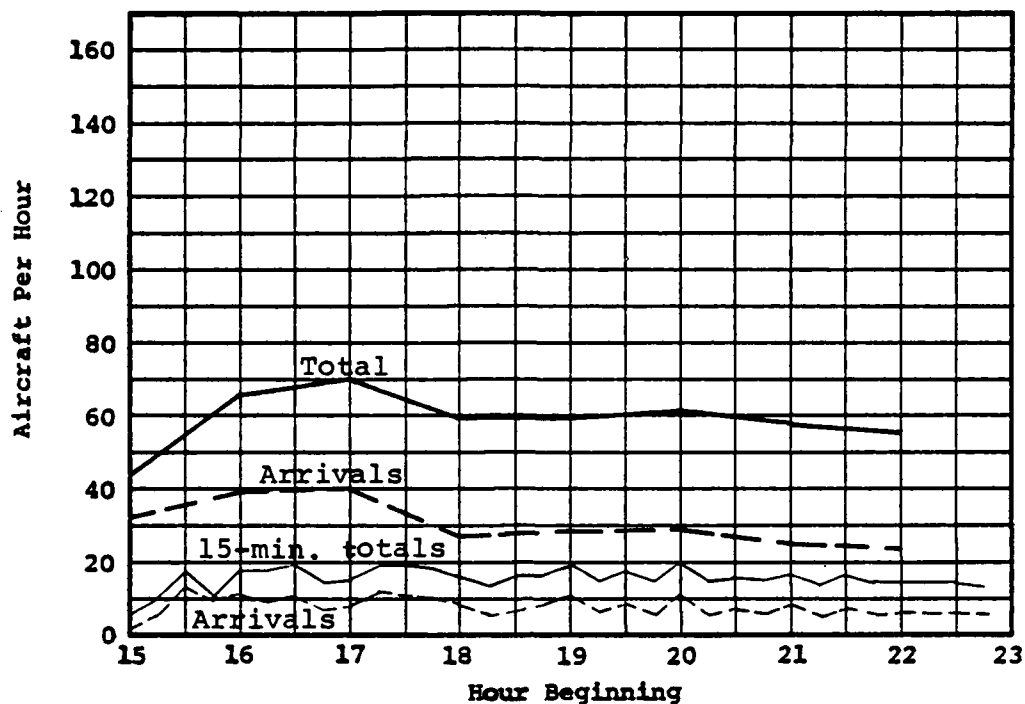


FIGURE 3B AVERAGE RUNWAY DELAYS

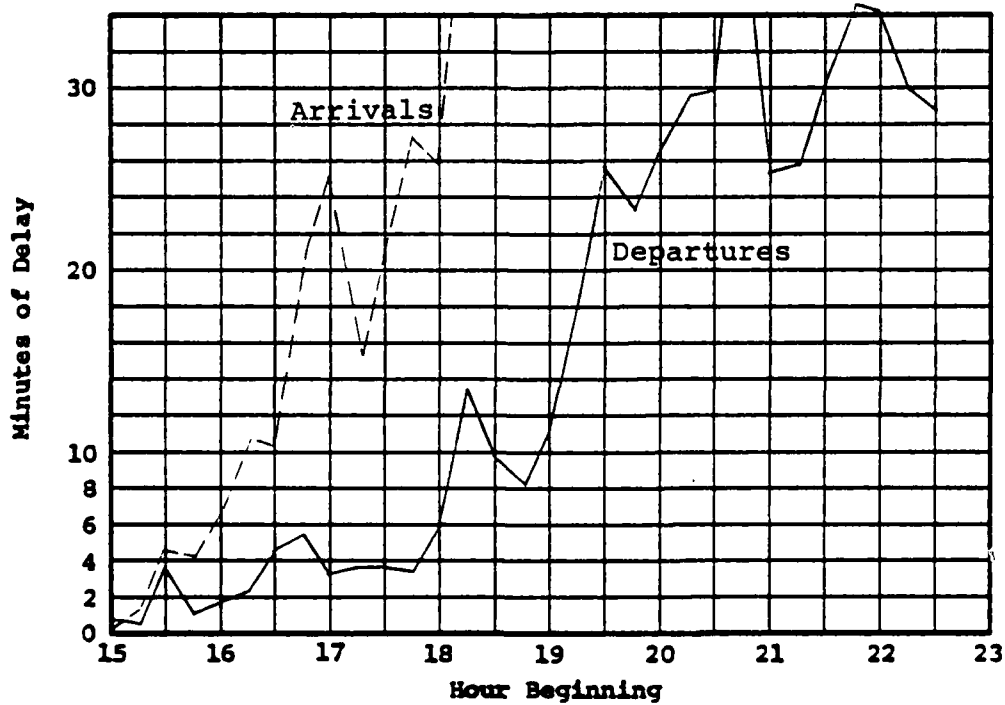


FIGURE 3C AVERAGE TAXIWAY DELAYS

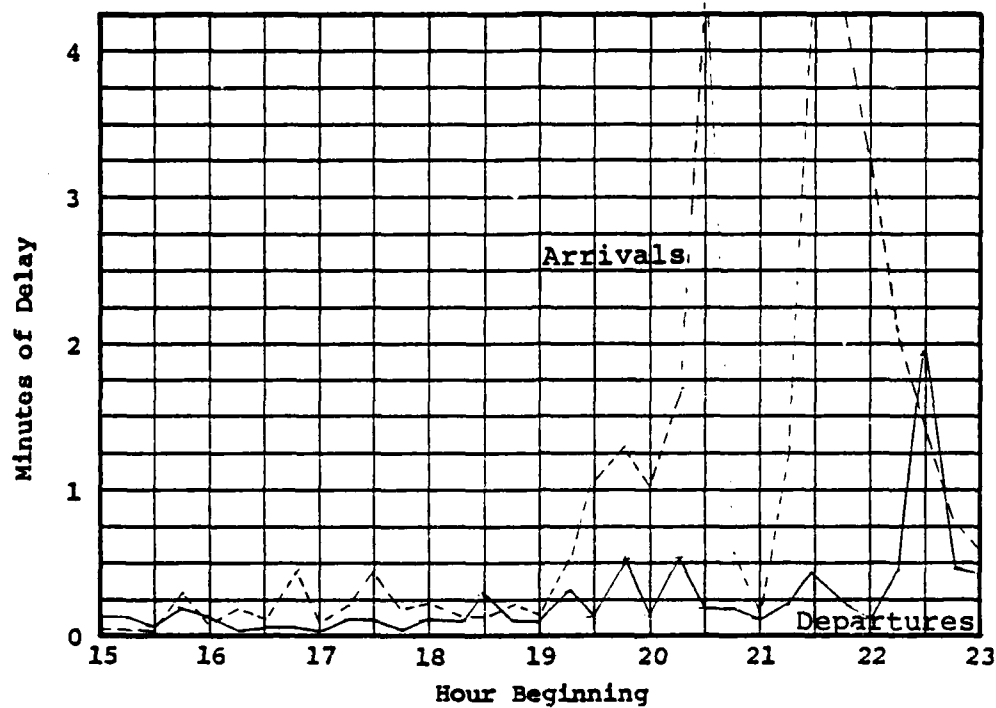
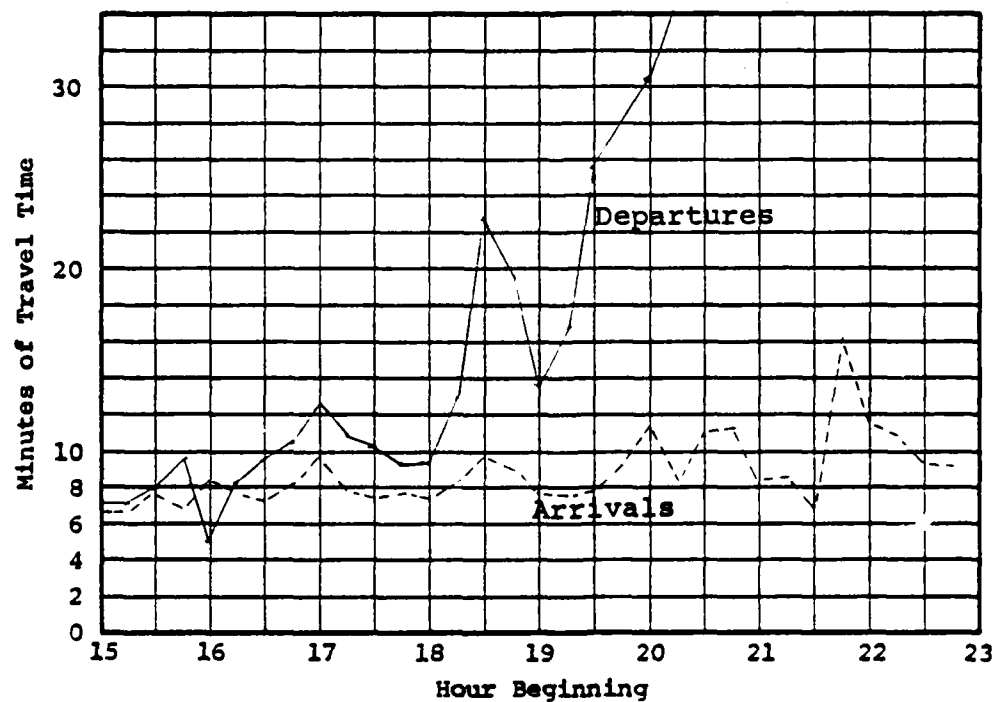


FIGURE 3D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTSExperiment No. 4Objective:

To obtain baseline capacity estimates in IFR1 conditions for the following runway-use configurations:

<u>Arrival Runways</u>	<u>Departure Runways</u>
------------------------	--------------------------

4R

4L

Related Comparison Experiments:

Experiment 3, which is in VFR1, has same runway-use configurations with 4L also used for arrivals and Experiment 18 has similar configurations but with 2-mile staggered arrivals.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 4A shows that total aircraft flows vary from 32 to 56 aircraft per hour over the 8-hour simulation run. The peak hour is from 21:00 to 22:00 hours and contained 23 arrivals and 33 departures. Figures 4A and 4B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 16 aircraft per hour, which is 29 percent of the corresponding peak-hour total flow rate.

Figure 4B shows that average delays by 15-minute intervals to aircraft using the runways are as high as 201.3 minutes per aircraft. Peak hour average delays are 201.3 minutes for arrivals and 13.2 minutes for departures.

Figure 4C shows that the peak-period average delays to aircraft using the taxiways are 0.2 minutes for taxi-in and 0.3 minutes for taxi-out.

Figure 4D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 4A AVERAGE RUNWAY FLOW RATES

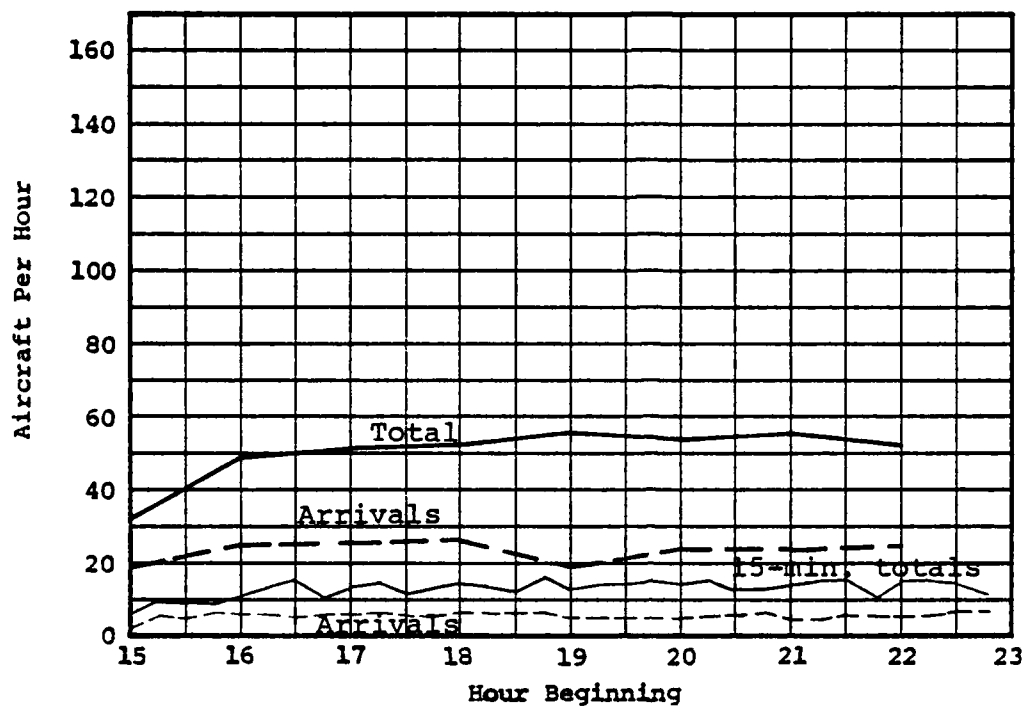


FIGURE 4B AVERAGE RUNWAY DELAYS

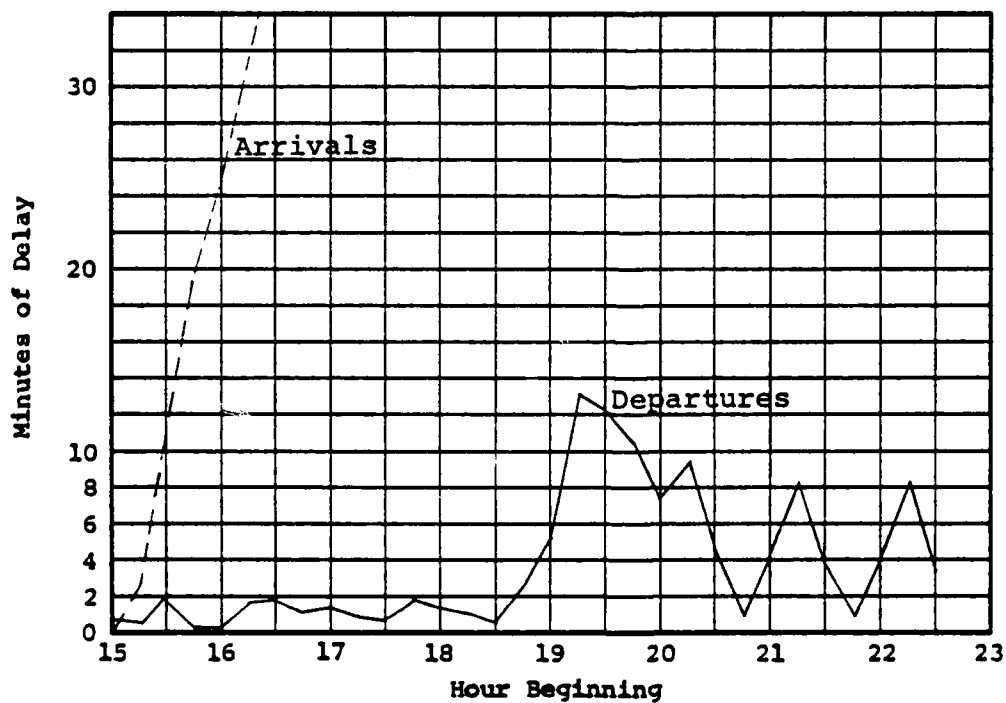


FIGURE 4C AVERAGE TAXIWAY DELAYS

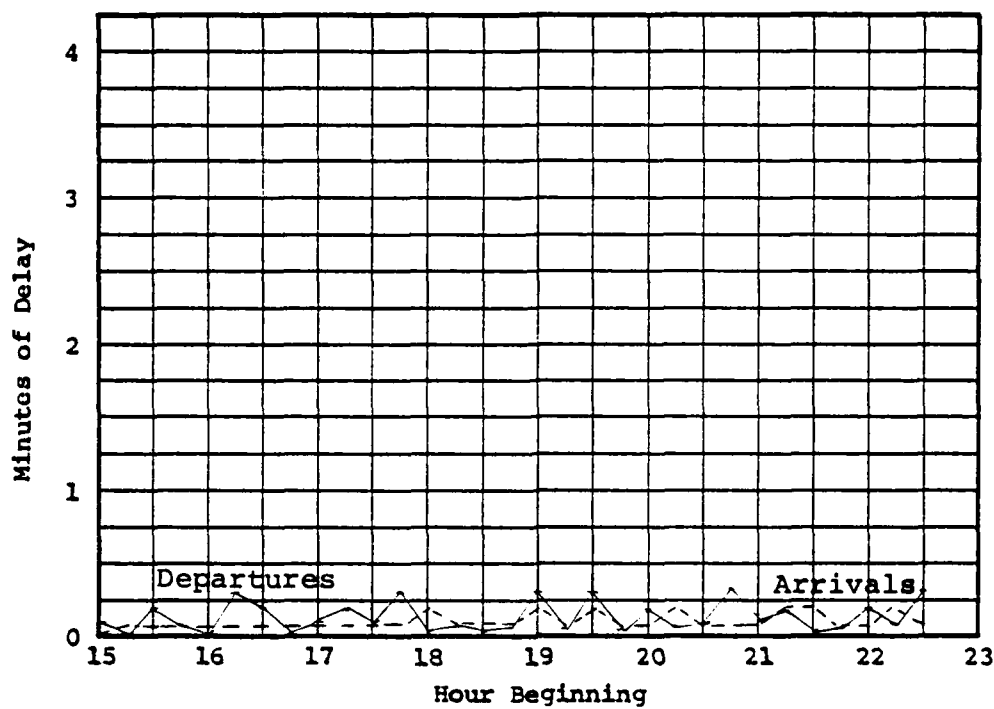
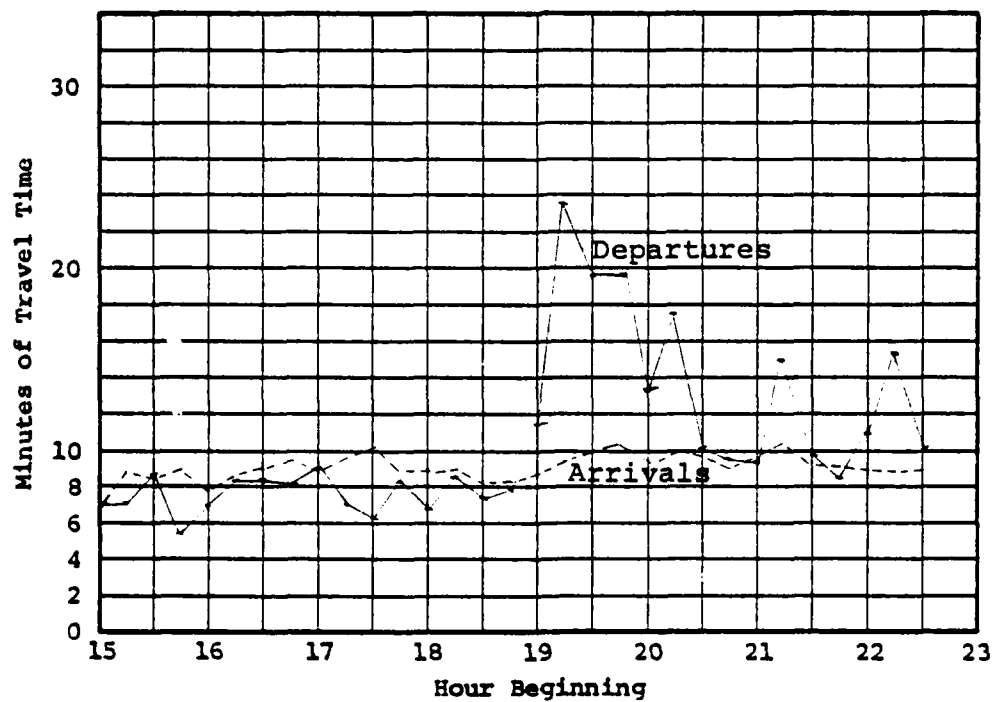


FIGURE 4D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTS

Experiment No. 18

Objective:

To provide estimates of the expected delay reduction associated with using 2-mile staggered separations on Runways 4L and 4R is less than visual conditions in periods of high arrival demand.

Related Comparison Experiments:

Experiment 3, a VFR1 experiment, has a similar runway configuration, but Experiment 4 provides a direct comparison for this experiment.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Anticipated Results:

Greater arrival capacity and lower arrival delays than in Experiment 4.

Results:

Figures 18A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment</u>		<u>Experiment No. 4</u>	
			<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	34	17-18	76	18-19
Arrival	Runway Delay	min.	138.8	22:30	201.3	22:15
Arrival	Taxi-In Delay	min.	2.1	20:15	0.2	many
Departure	Flow Rate	a/c per hr.	36	21-22	36	19-20
Departure	Runway Delay	min.	26.8	20:30	13.2	19:15
Departure	Taxi-Out Delay	min.	0.3	many	0.3	many

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 18A AVERAGE RUNWAY FLOW RATES

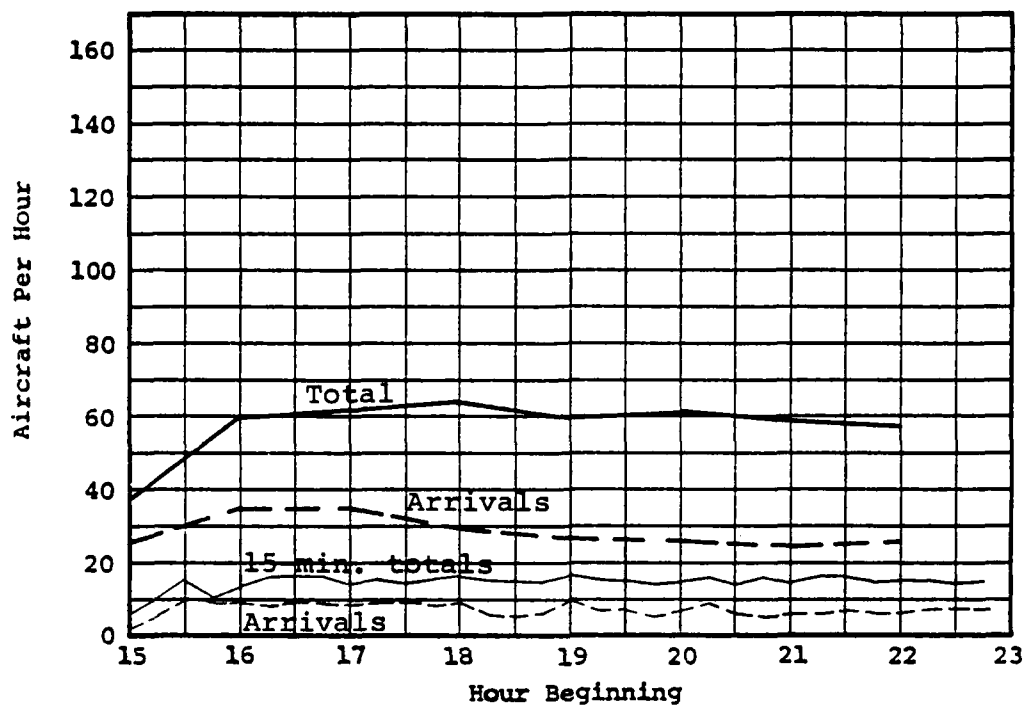


FIGURE 18B AVERAGE RUNWAY DELAYS

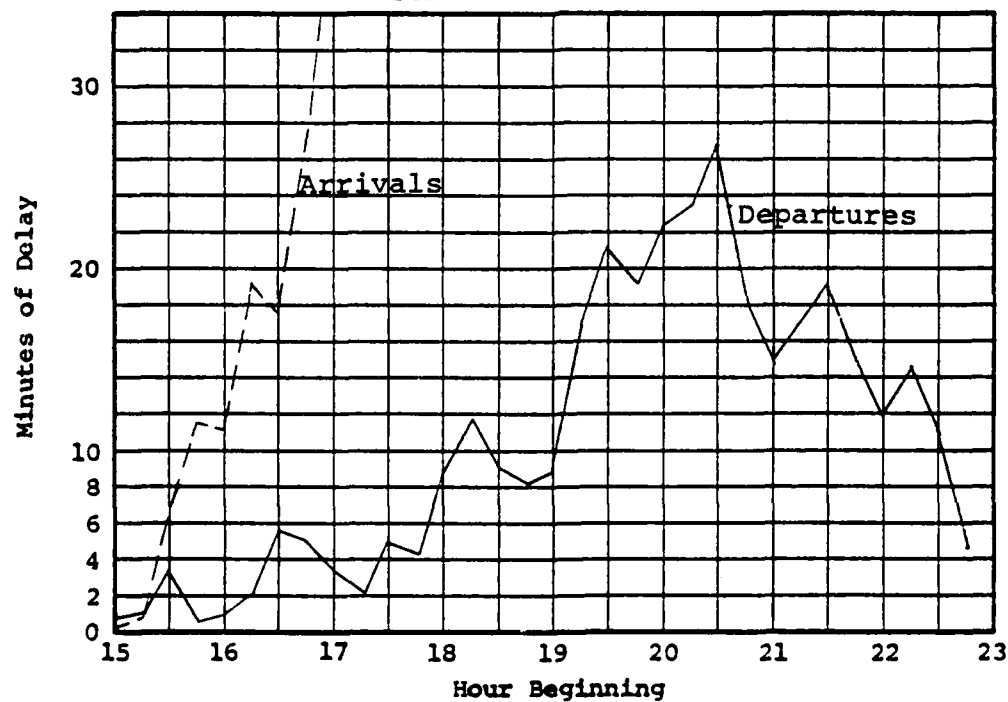


FIGURE 18C AVERAGE TAXIWAY DELAYS

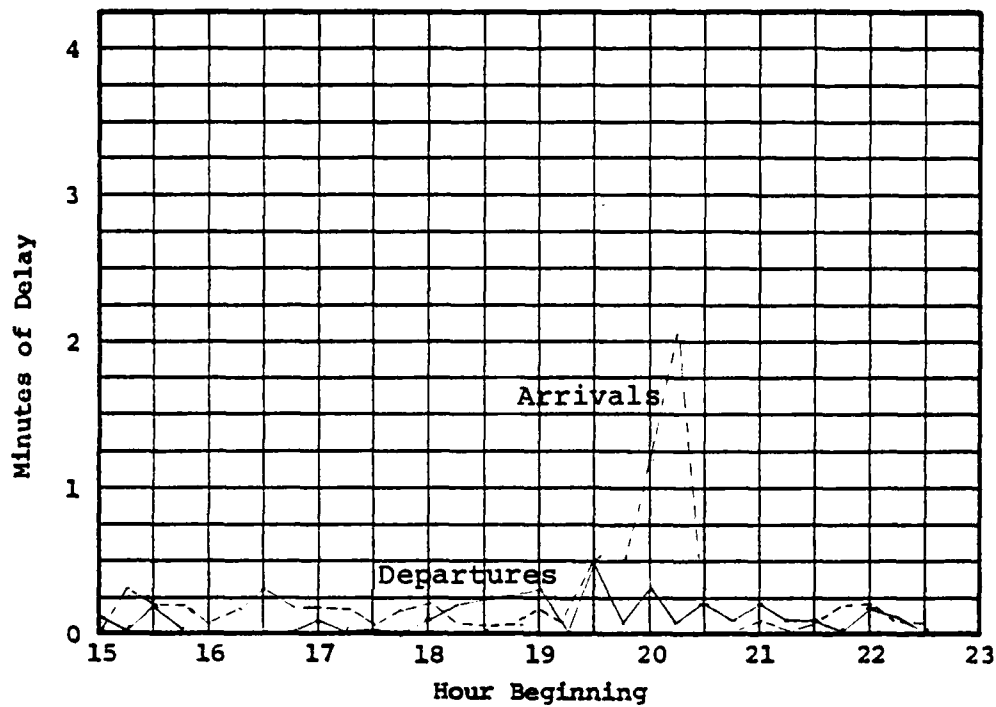
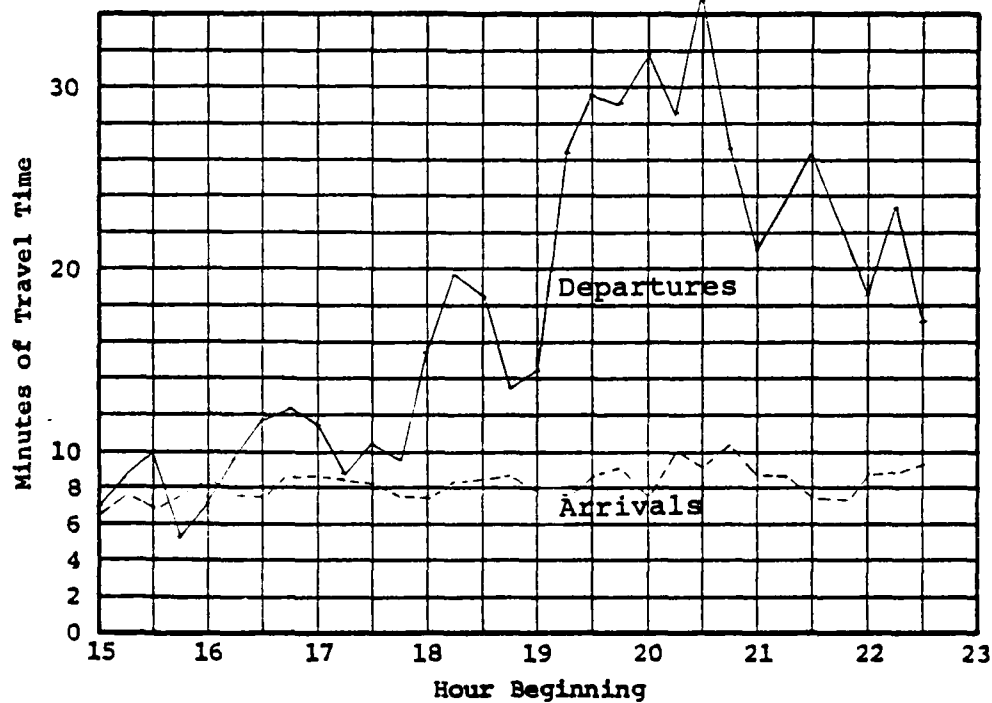


FIGURE 18D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTSExperiment No. 5Objective:

To obtain baseline delay estimates in VFR1 for the following runway-use configuration:

<u>Arrival Runways</u>	<u>Departure Runways</u>
------------------------	--------------------------

31L, 31R

31L

Related Comparison Experiments:

Experiment 16, also in VFR1, has same configuration but with short-range departures on 31R and independent departure tracks. Experiments 6 and 15 have the same basic runway-use configuration but in IFR1.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 5A shows that total aircraft flows vary from 47 to 80 aircraft per hour over the 8-hour simulation run. The peak hour is from 17:00 to 18:00 hours and contained 49 arrivals and 31 departures. Figures 5A and 5B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 24 aircraft per hour, which is 30 percent of the corresponding peak-hour total flow rate.

Figure 5B shows that average delays by 15-minute intervals to aircraft using the runways are as high as 12.8 minutes per aircraft. Peak hour average delays are 5.2 minutes for arrivals and 12.8 minutes for departures.

Figure 5C shows that the peak-period average delays to aircraft using the taxiways are 0.5 minutes for taxi-in and 0.5 minutes for taxi-out.

Figure 5D shows average travel time for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 5A AVERAGE RUNWAY FLOW RATES

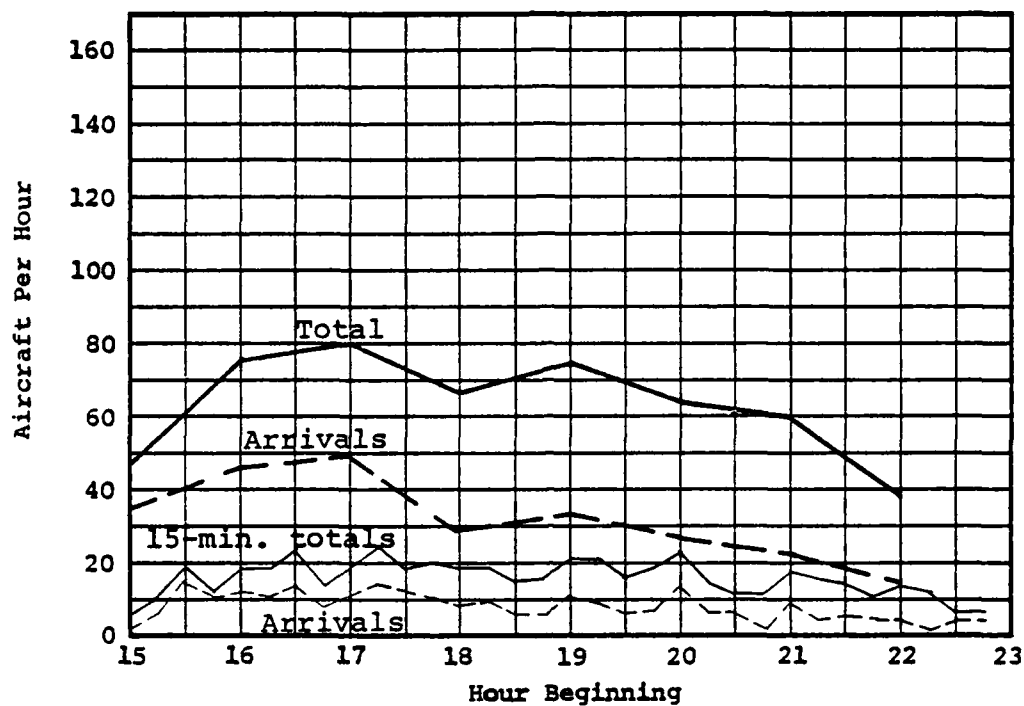


FIGURE 5B AVERAGE RUNWAY DELAYS

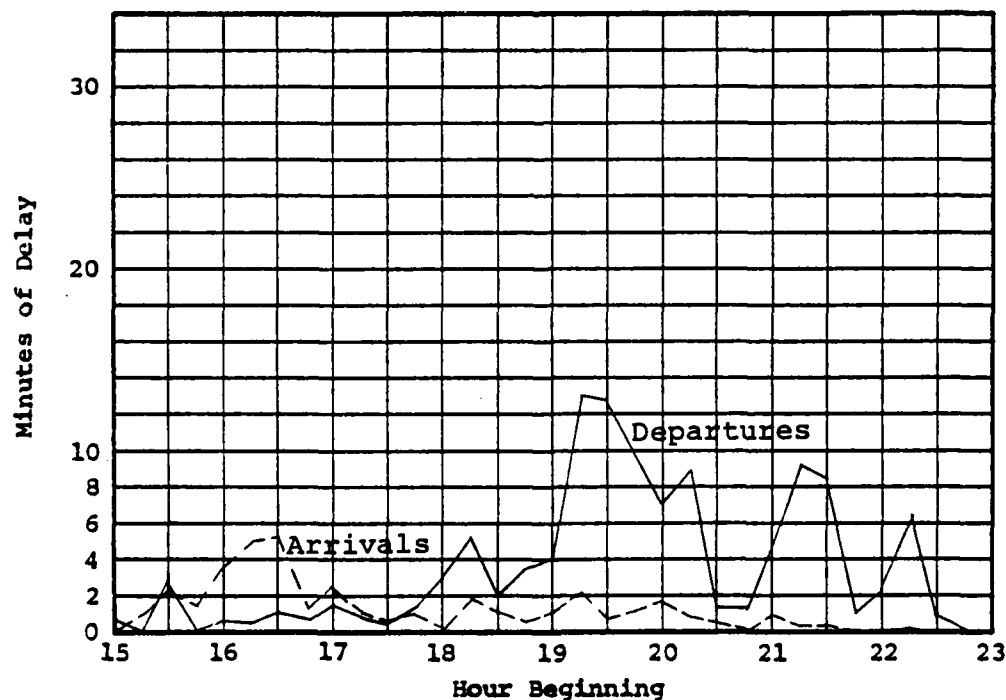


FIGURE 5C AVERAGE TAXIWAY DELAYS

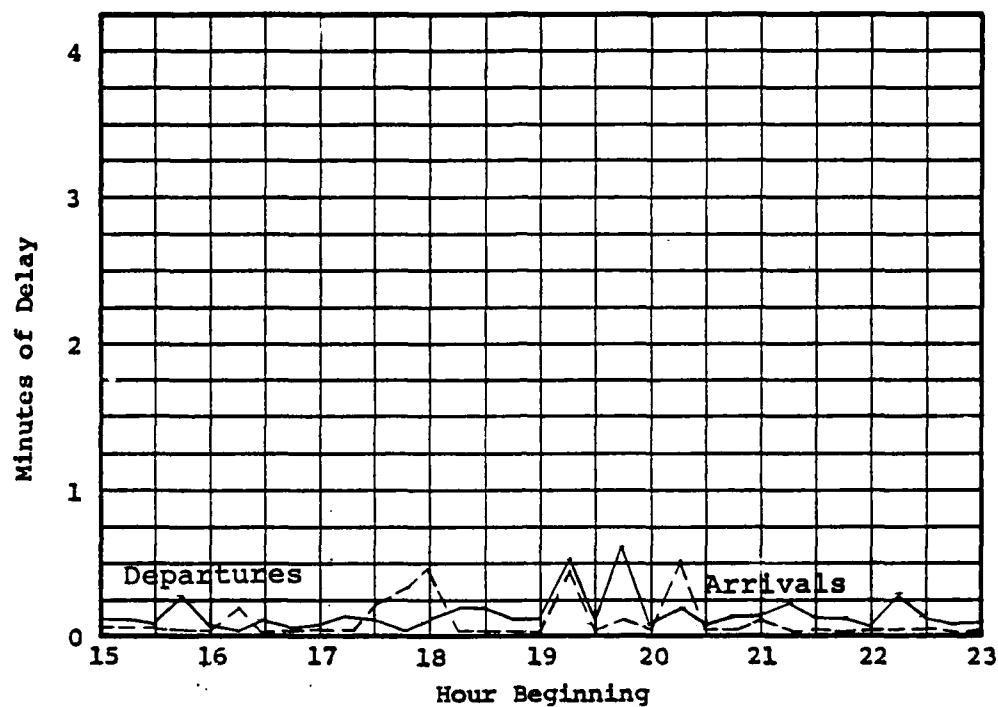
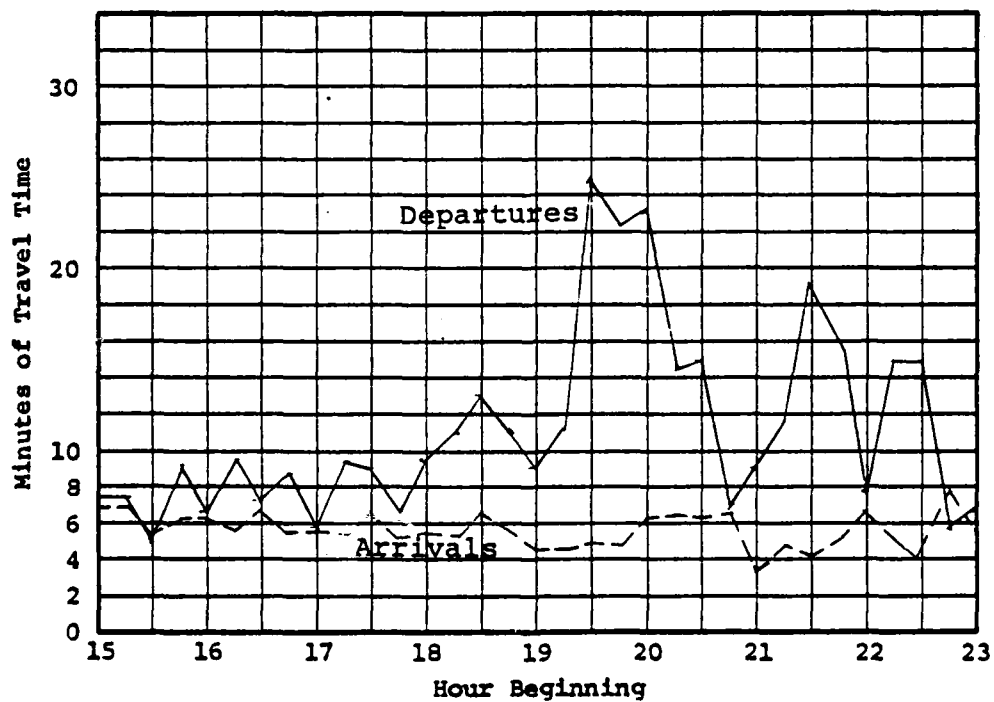


FIGURE 5D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTS

Experiment No. 16

Objective:

To investigate the potential benefits of independent departure tracks on runways 31L and 31R (31R used for short-range departures) in VFR conditions and the following runway-use configurations:

<u>Arrival Runways</u>	<u>Departure Runways</u>
31L, 31R	31L, 31R

Related Comparison Experiments:

The effect of the independent departures on 31L and 31R can be evaluated by comparing Experiment 16 with Experiment 5.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Anticipated Results:

Lower departure runway delays and higher departure capacity than in Experiment 5.

Results:

Figures 16A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment</u>		<u>Experiment No. 5</u>	
			<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	50	17-18	49	17-18
Arrival	Runway Delay	min.	3.2	16:30	5.2	16:30
Arrival	Taxi-In Delay	min.	1.0	20:00	0.5	20:00
Departure	Flow Rate	a/c per hr.	43	19-20	41	19-20
Departure	Runway Delay	min.	3.0	19:00	12.8	19:15
Departure	Taxi-Out Delay	min.	0.5	19:00	0.5	19:00

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 16A AVERAGE RUNWAY FLOW RATES

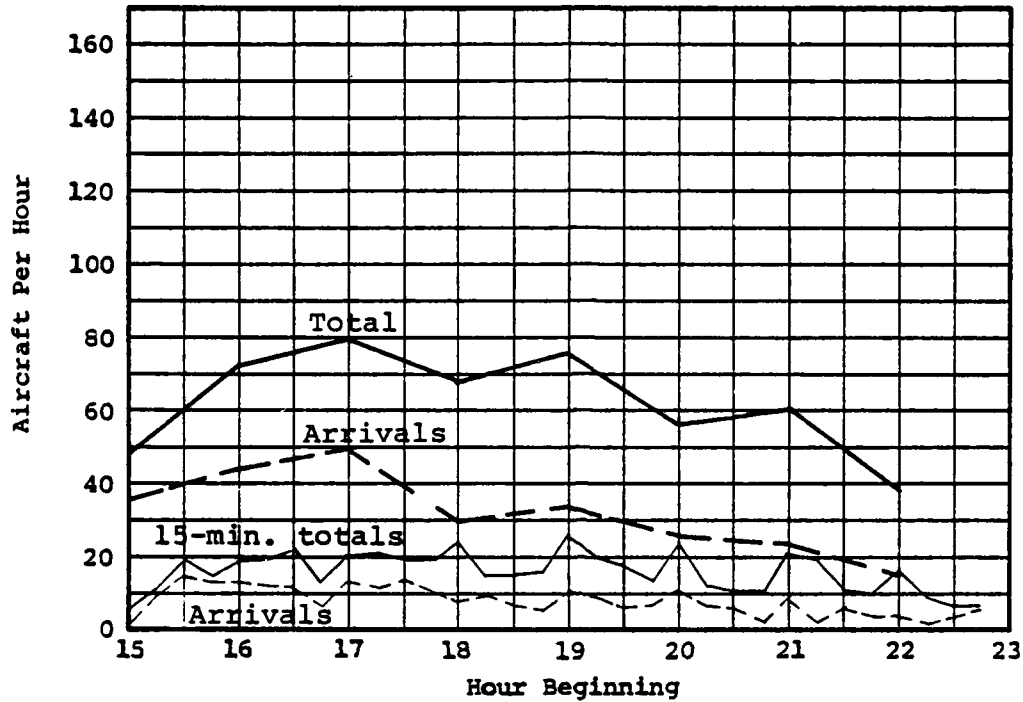


FIGURE 16B AVERAGE RUNWAY DELAYS

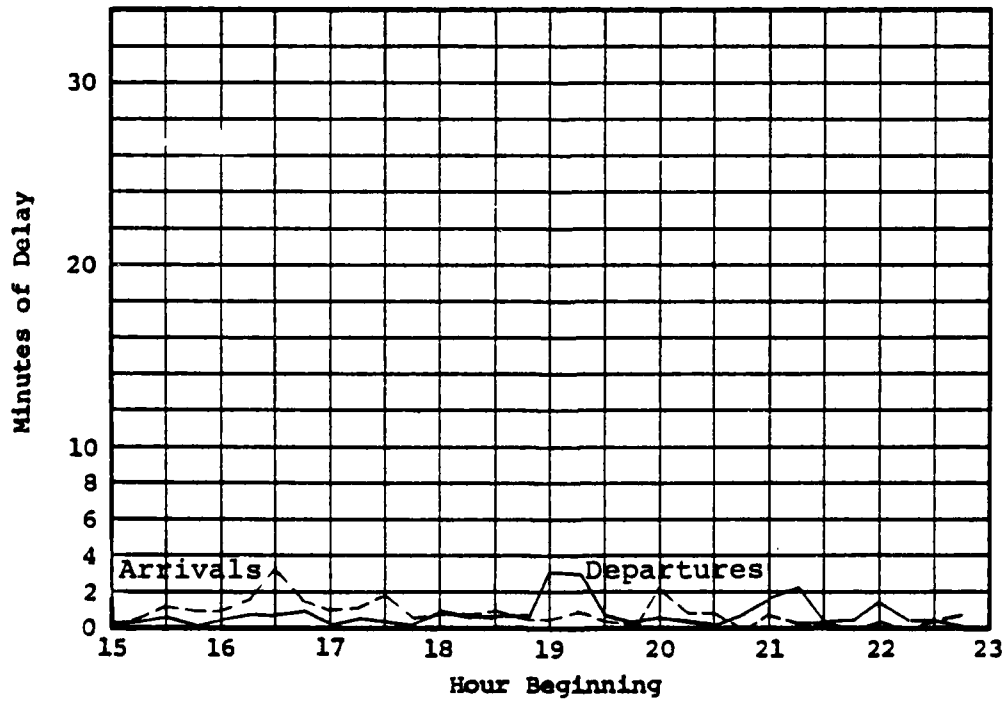


FIGURE 16C AVERAGE TAXIWAY DELAYS

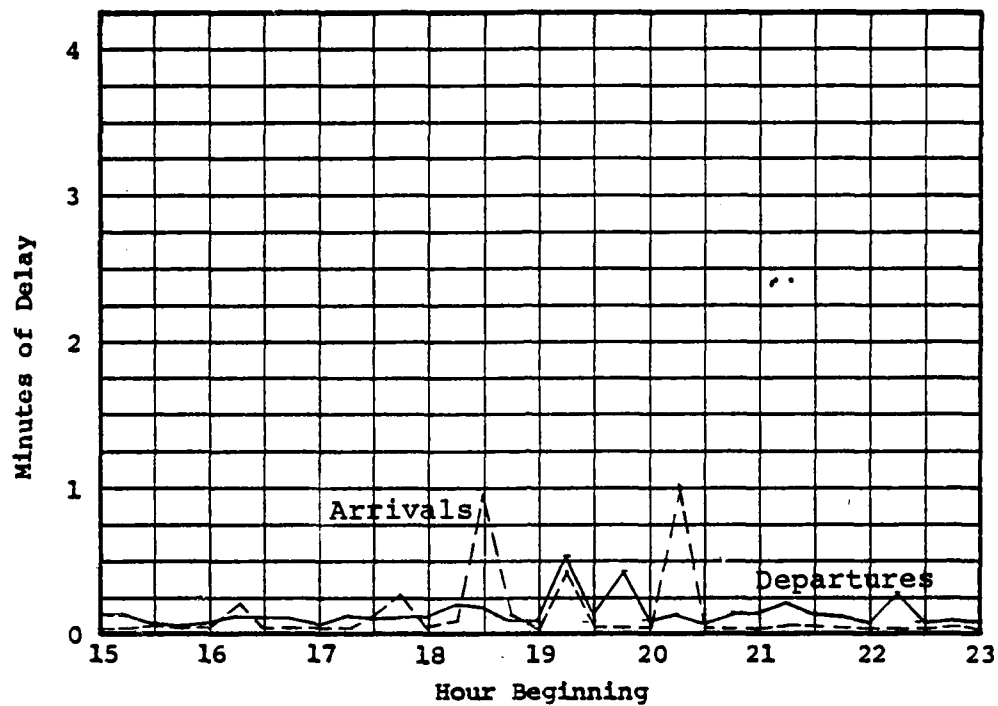
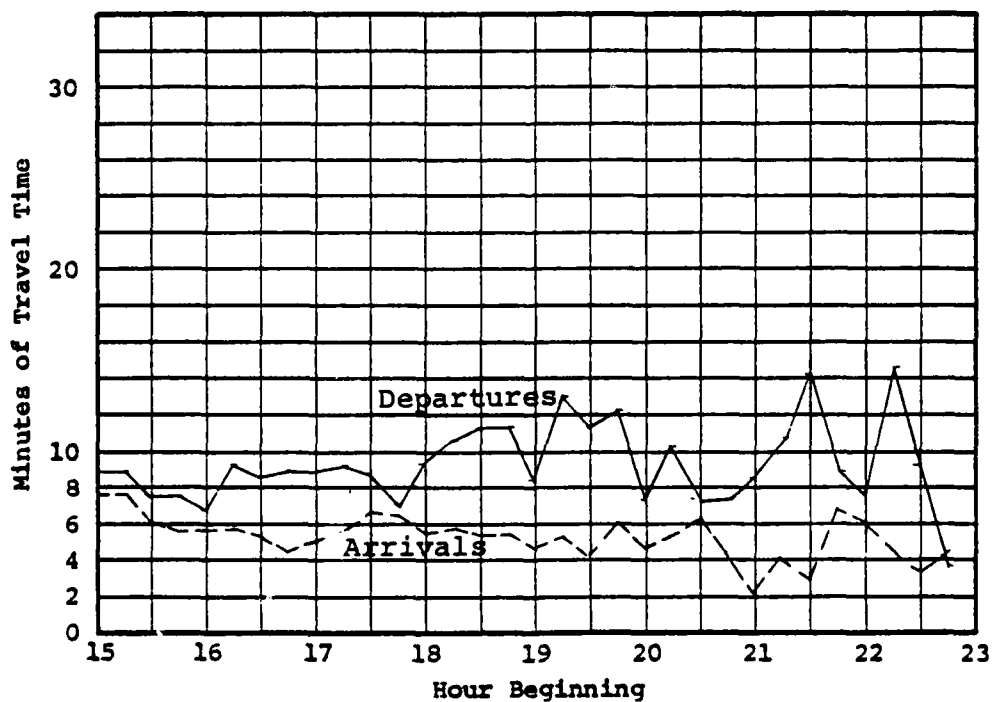


FIGURE 16D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTSExperiment No. 6Objective:

To provide baseline delay estimates in IFR1 conditions, for the following runway-use configurations:

<u>Arrival Runways</u>	<u>Departure Runways</u>
31R	31L

Related Comparison Experiments:

Experiment 15 will have the same basic runway-use configurations in IFR1 but with independent arrivals and independent departures on both R31R and R31L.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 6A shows that total aircraft flows vary from 32 to 67 aircraft per hour over the 8-hour simulation run. The peak hour is from 19:00 to 20:00 hours and contained 26 arrivals and 41 departures. Figures 6A and 6B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 19 aircraft per hour, which is 28 percent of the corresponding peak-hour total flow rate.

Figure 6B shows that average delays by 15-minute intervals to aircraft using the runways are as high as 151.7 minutes per aircraft. Peak hour average delays are 151.7 minutes for arrivals and 11.4 minutes for departures.

Figure 6C shows that the peak-period average delays to aircraft using the taxiways are 0.2 minutes for taxi-in and 0.3 minutes for taxi-out.

Figure 6D shows average travel times for arrivals (thresholds-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 6A AVERAGE RUNWAY FLOW RATES

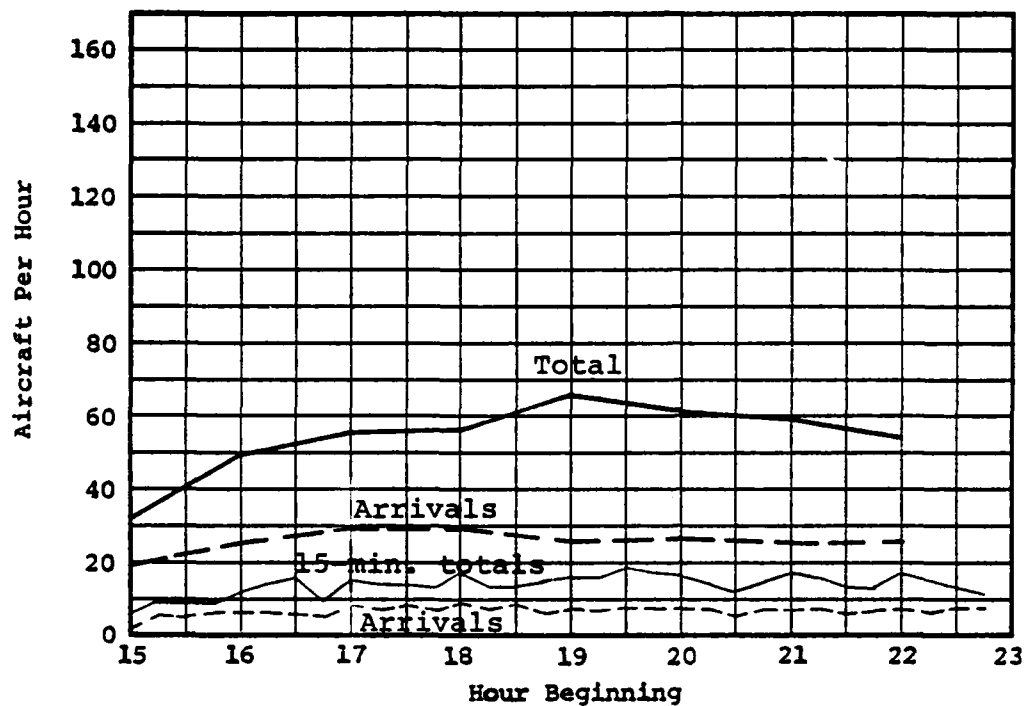


FIGURE 6B AVERAGE RUNWAY DELAYS

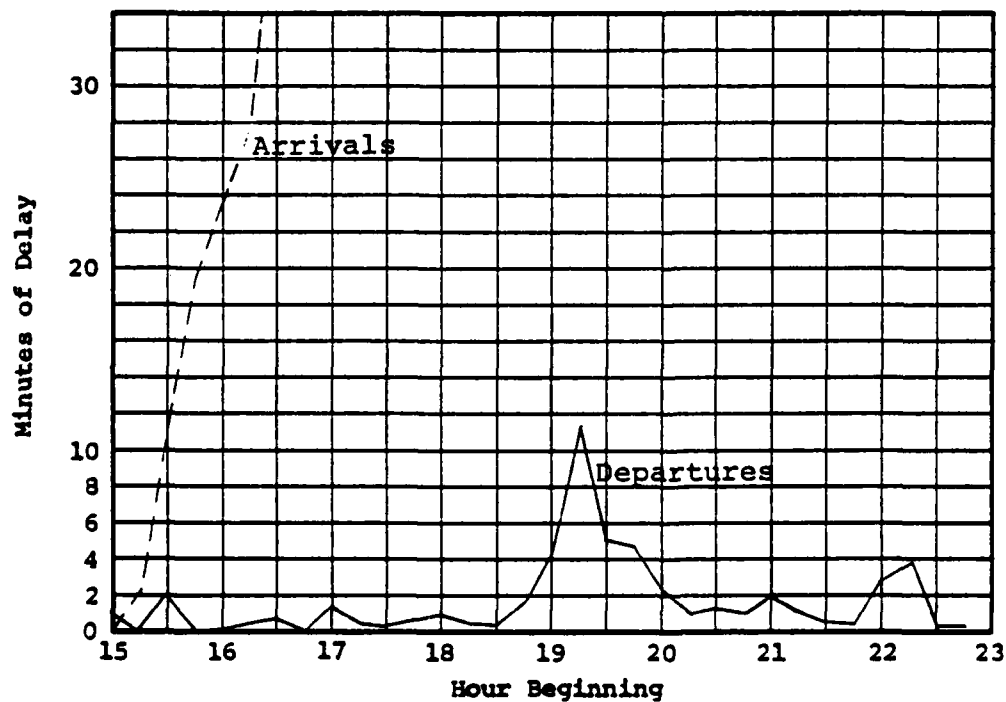


FIGURE 6C AVERAGE TAXIWAY DELAYS

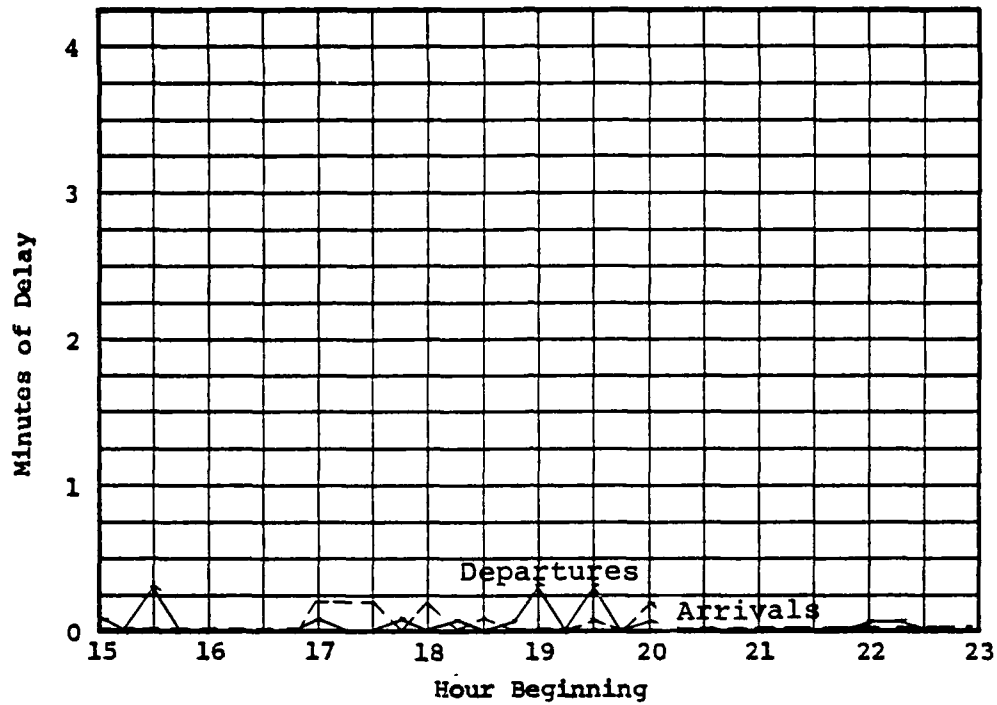
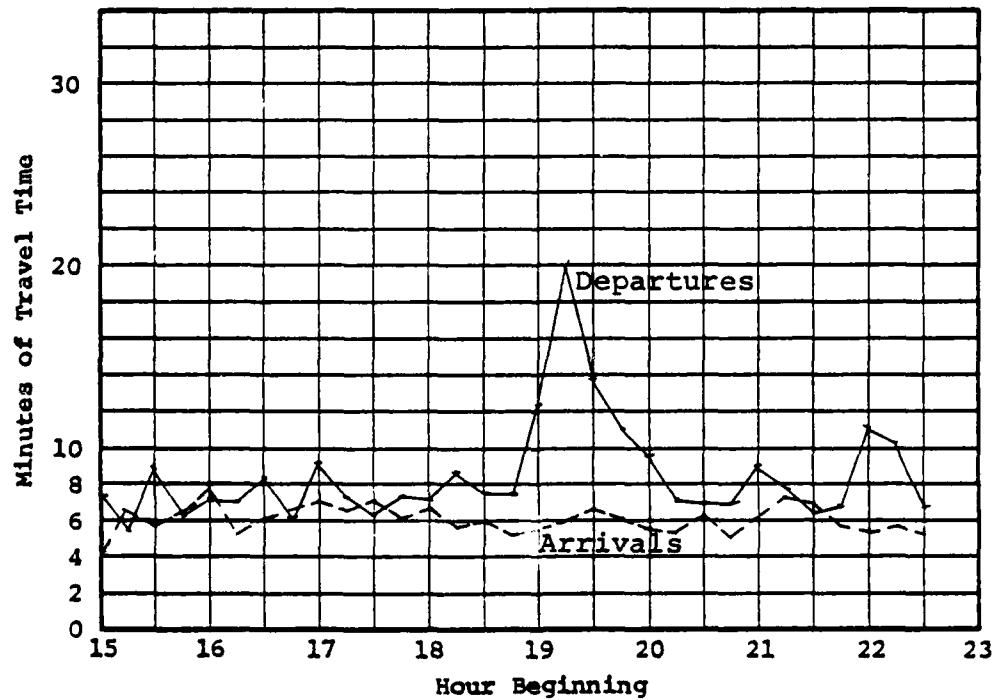


FIGURE 6D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTS

Experiment No. 15

Objective:

To investigate the potential delay savings associated with having independent arrivals, independent departures, and independent missed approach tracks on Runways 31R and 31L in IFR1 conditions.

Related Comparison Experiments:

Experiment 6 serves as the basis for evaluating the impact of the improvements in Experiment 15.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Anticipated Results:

Lower arrival and departure delays and greater capacities than in Experiment 6.

Results:

Figures 15A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment</u>		<u>Experiment No. 6</u>	
			<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	49	17-18	29	17-18
Arrival	Runway Delay	min.	6.4	16:30	151.7	22:30
Arrival	Taxi-In Delay	min.	1.0	20:00	0.2	many
Departure	Flow Rate	a/c per hr.	43	19-20	41	19-20
Departure	Runway Delay	min.	3.2	19:00	11.4	19:15
Departure	Taxi-Out Delay	min.	0.6	19:00	0.3	many

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 15A AVERAGE RUNWAY FLOW RATES

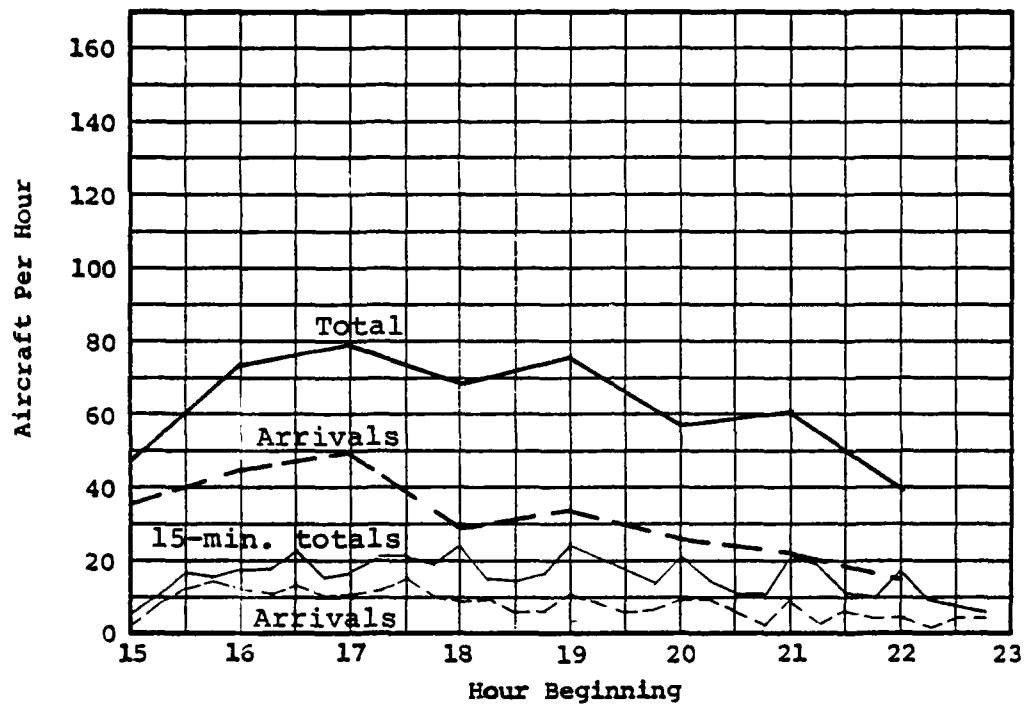


FIGURE 15B AVERAGE RUNWAY DELAYS

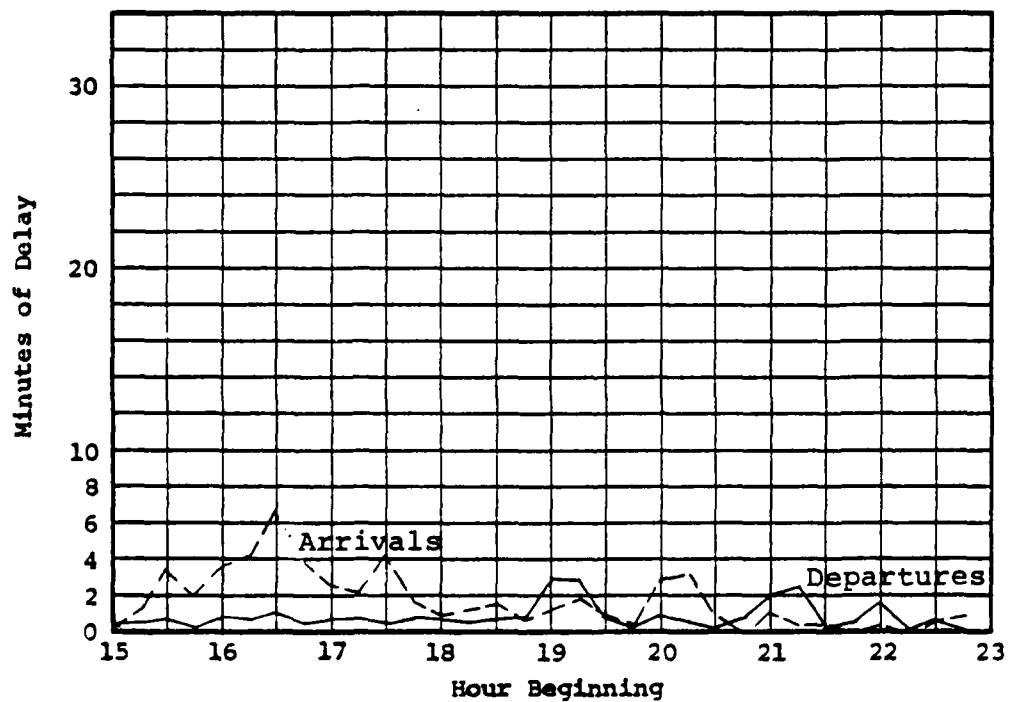


FIGURE 15C AVERAGE TAXIWAY DELAYS

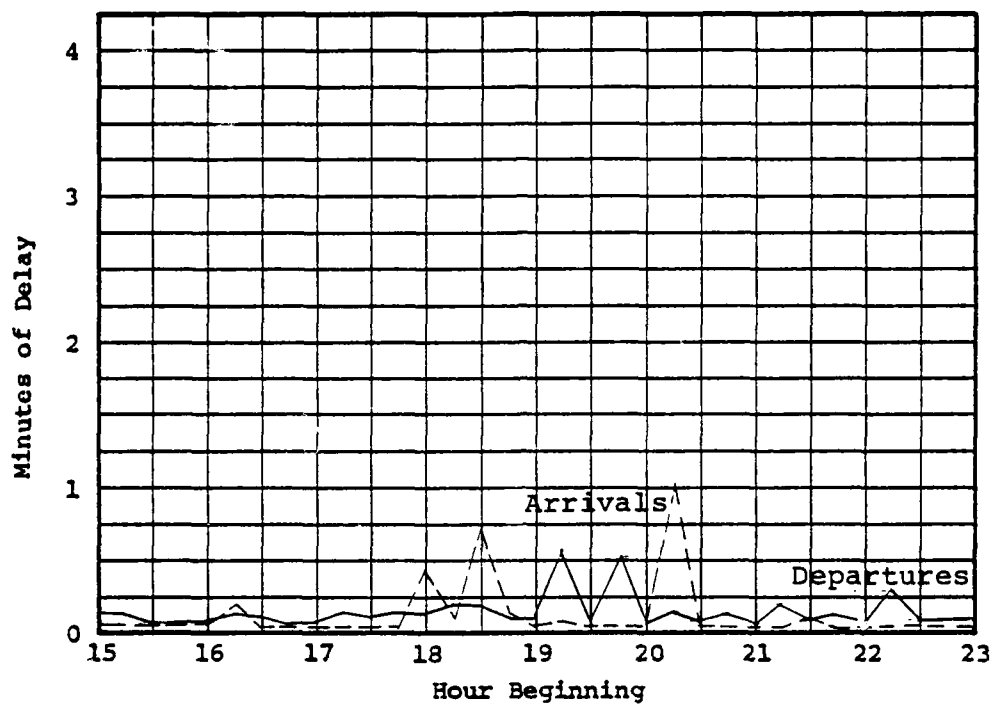
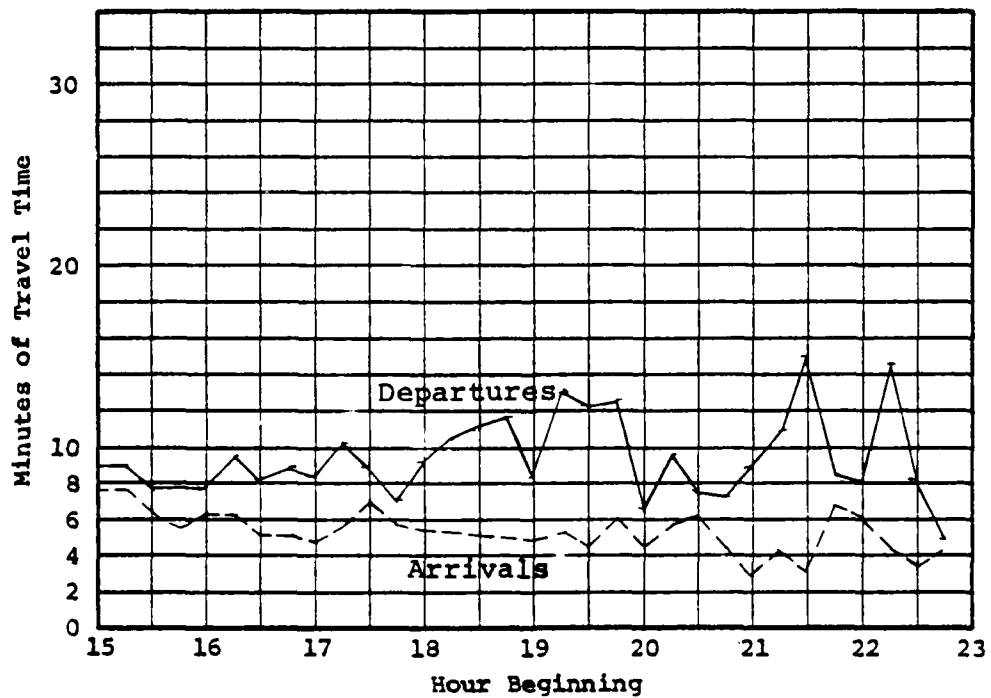


FIGURE 15D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTSExperiment No. 7Objective:

To obtain baseline delay estimates, in VFR1 conditions, for the following runway-use configuration:

Arrival Runway Departure Runways

13L, 13R

13R

Related Comparison Experiments:

Experiment 8 has the same basic runway-use configuration in IFR1 conditions.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 7A shows that total aircraft flows vary from 49 to 79 aircraft per hour over the 8-hour simulation run. The peak hour is from 17:00 to 18:00 hours and contained 49 arrivals and 30 departures. Figures 7A and 7B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 24 aircraft per hour, which is 28 percent of the corresponding peak-hour total flow rate.

Figure 7B shows that average delays by 15-minute intervals to aircraft using the runways are as high as 1.4 minutes per aircraft. Peak hour average delays are 1.4 minutes for arrivals and 0.6 minutes for departures.

Figure 7C shows that the peak-period average delays to aircraft using the taxiways are 15.3 minutes for taxi-in and 0.6 minutes for taxi-out.

Figure 7D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 7A AVERAGE RUNWAY FLOW RATES

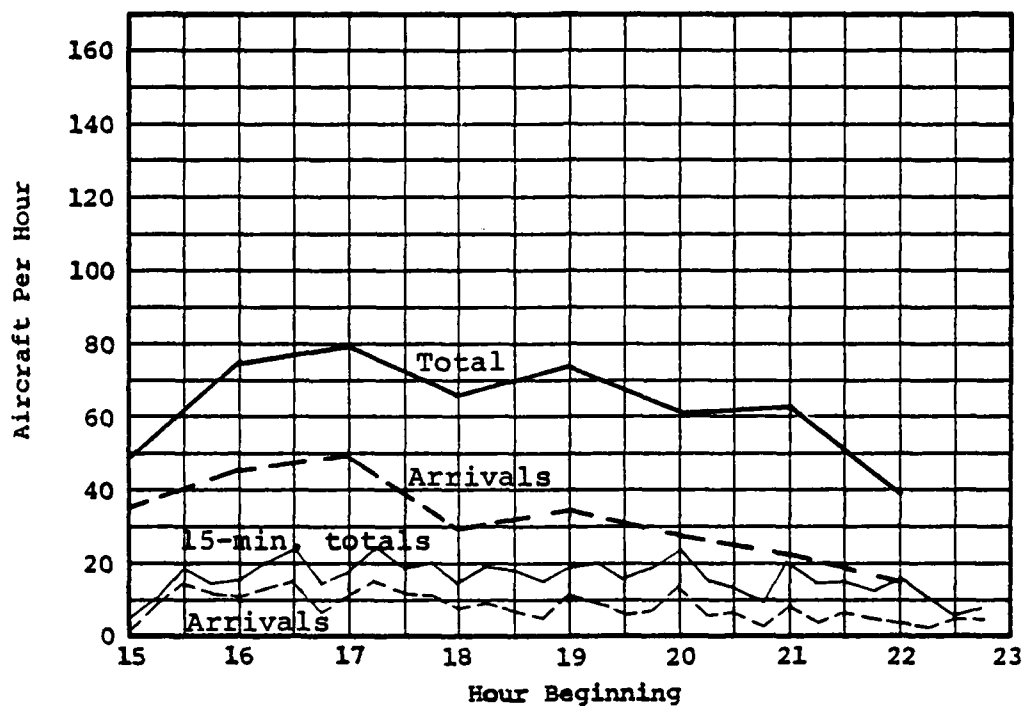


FIGURE 7B AVERAGE RUNWAY DELAYS

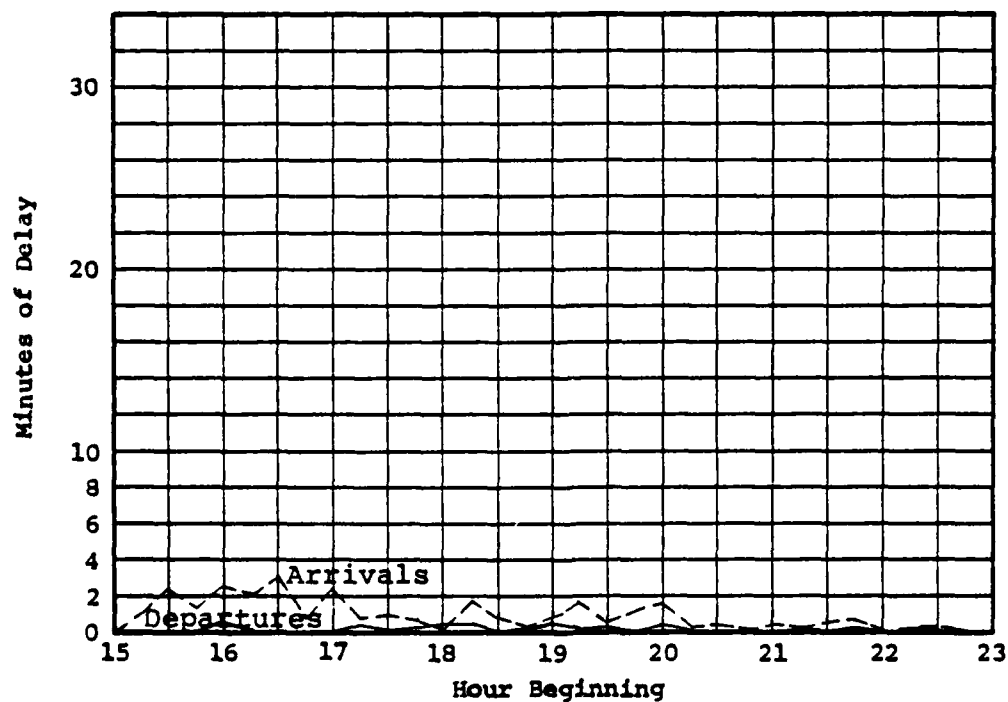


FIGURE 7C AVERAGE TAXIWAY DELAYS

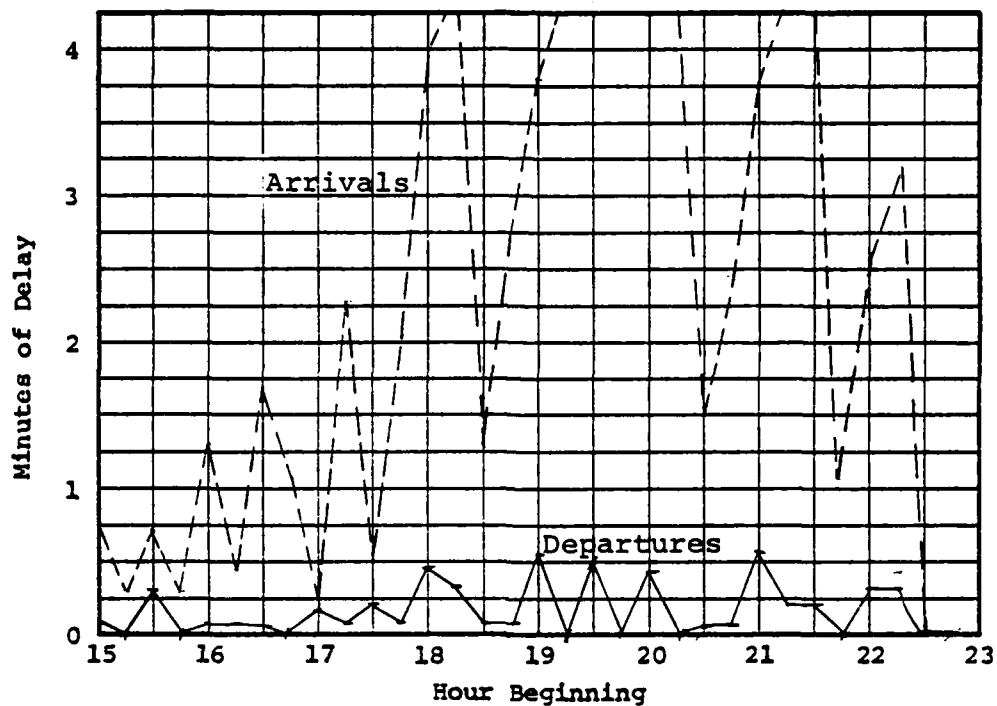
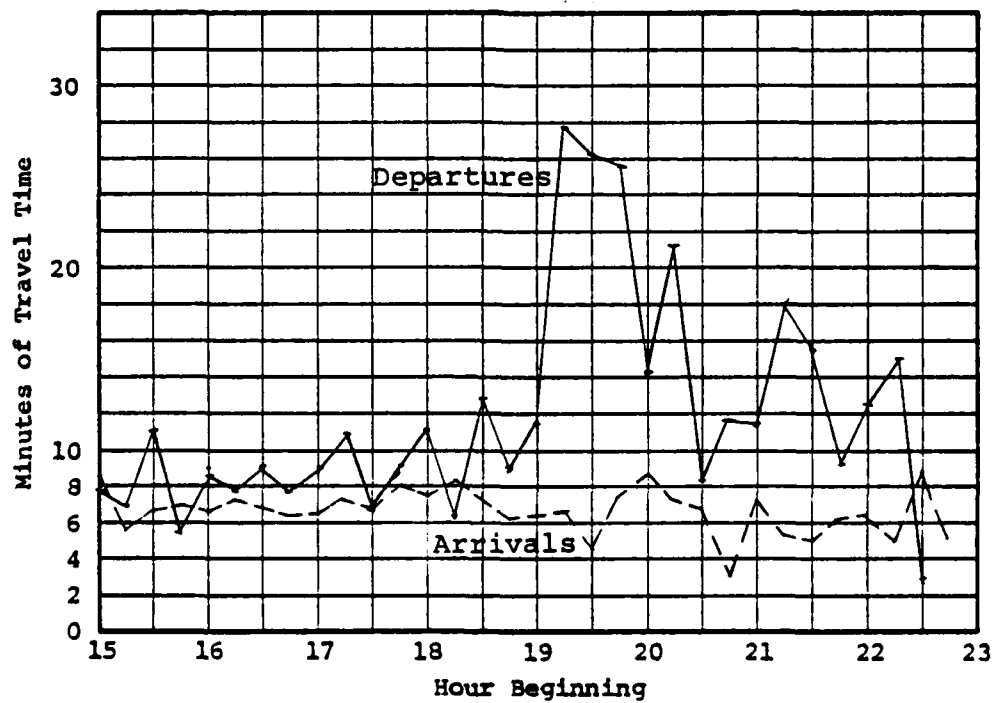


FIGURE 7D AVERAGE TAXIWAY TRAVEL TIMES



JFK STAGE - 1 EXPERIMENTSExperiment No. 8Objective:

To obtain baseline capacity estimates, in IFR1 weather conditions, for the following runway-use configuration:

<u>Arrival Runways</u>	<u>Departure Runways</u>
13L	13R

Related Comparison Experiments:

Experiment No. 7 has the same basic runway-use configurations but is in VFR1 conditions.

Length and Level of Detail of Simulation Run:

From 15:00 to 23:00 with 15-minute summaries.

Results:

Figure 8A shows that total aircraft flows vary from 33 to 66 aircraft per hour over the 8-hour simulation run. The peak hour is from 19:00 to 20:00 hours and contained 26 arrivals and 40 departures. Figures 8A and 8B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 18 aircraft per hour, which is 29 percent of the corresponding peak-hour total flow rate.

Figure 8B shows that average delays by 15-minute intervals to aircraft using the runways are as high as 133.2 minutes per aircraft. Peak hour average delays are 133.2 minutes for arrivals and 9.5 minutes for departures.

Figure 8C shows that the peak-period average delays to aircraft using the taxiways are 0.6 minutes for taxi-in and 0.1 minutes for taxi-out.

Figure 8D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 8A AVERAGE RUNWAY FLOW RATES

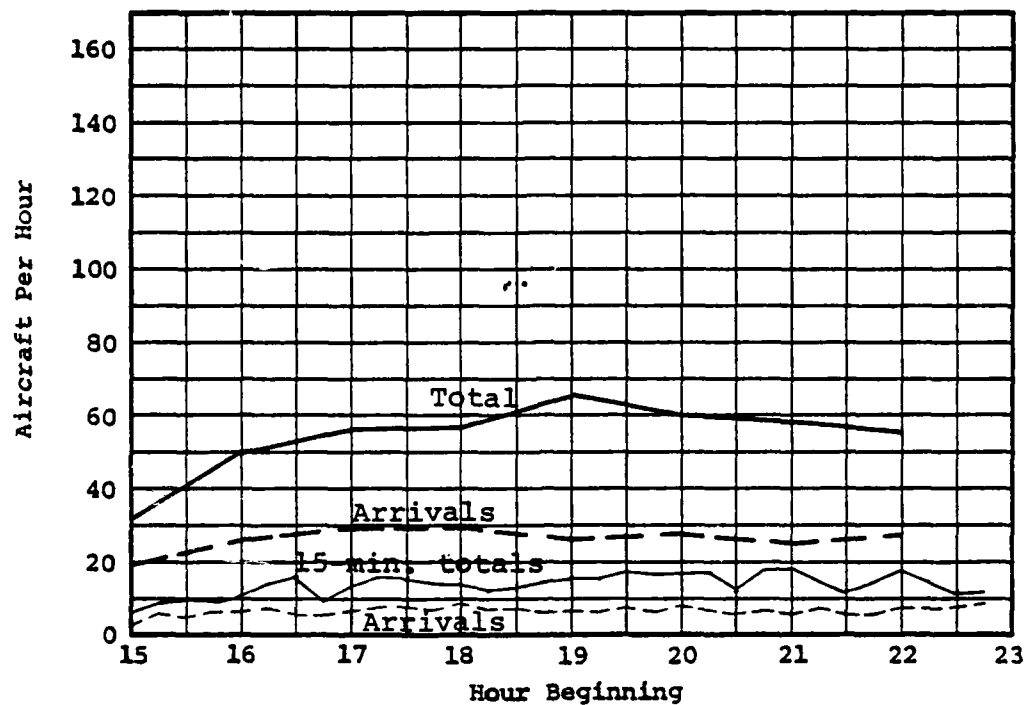


FIGURE 8B AVERAGE RUNWAY DELAYS

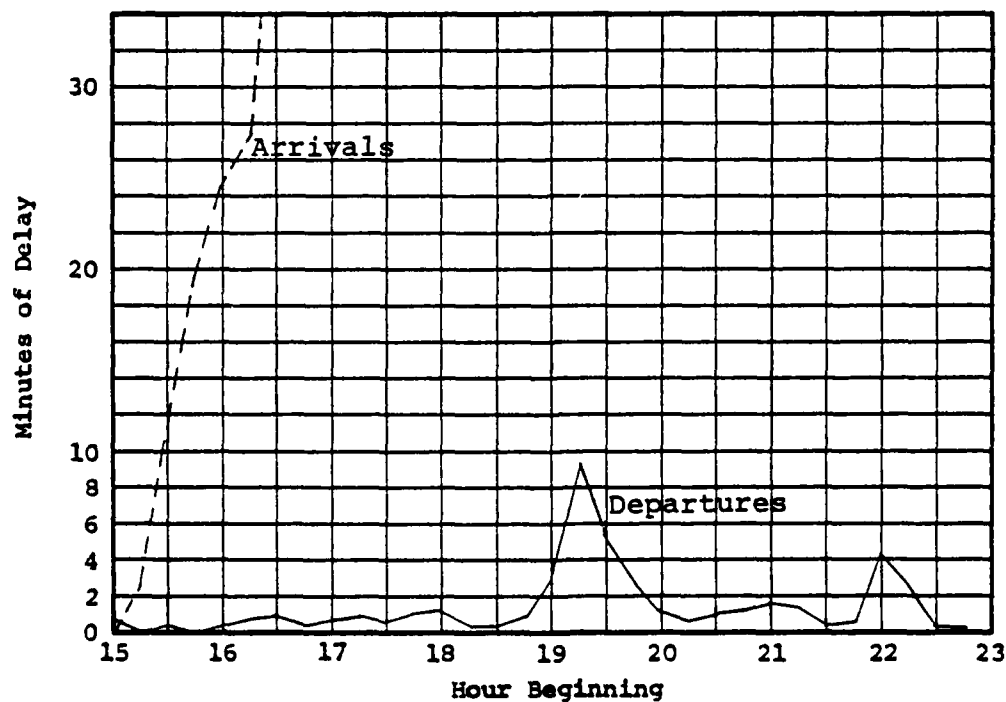


FIGURE 8C AVERAGE TAXIWAY DELAYS

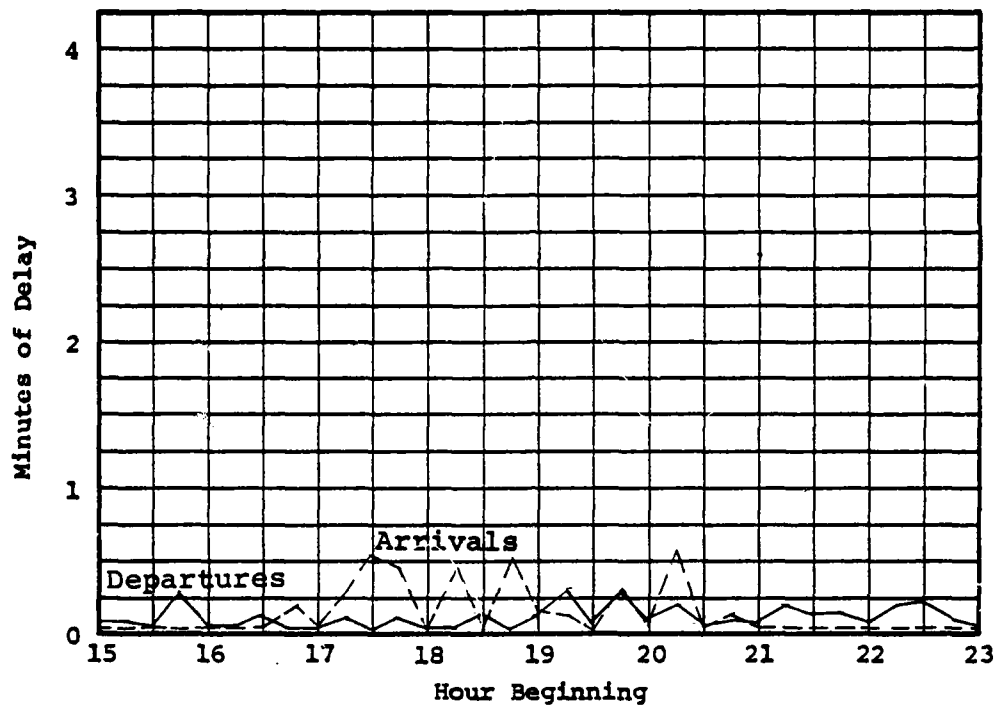
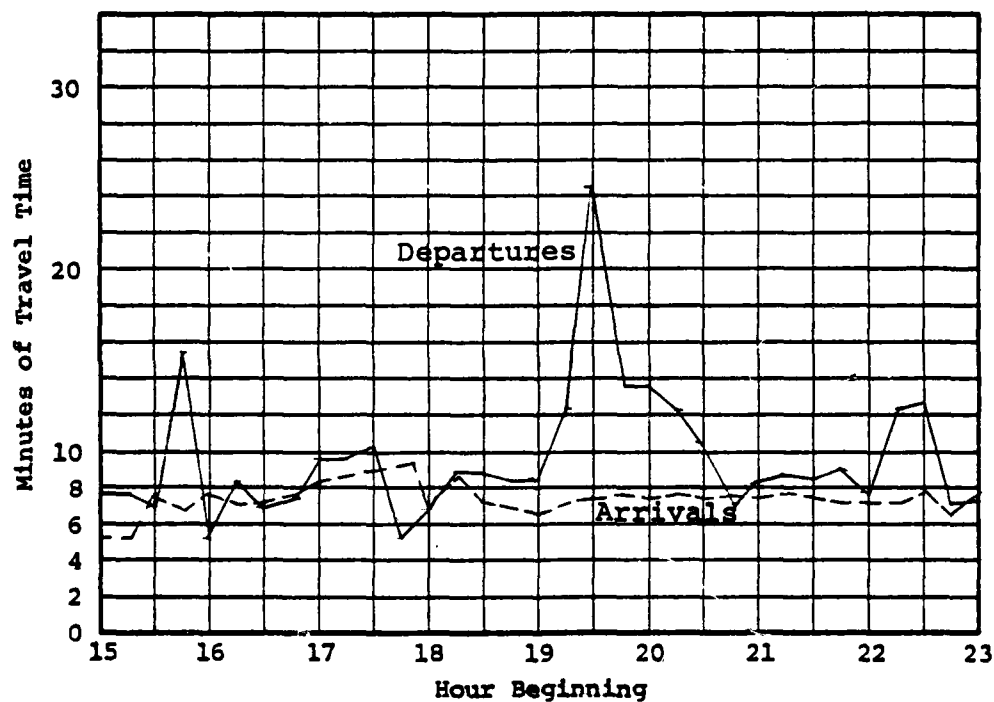


FIGURE 8D AVERAGE TAXIWAY TRAVEL TIMES



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Attachment B

RESULTS OF STAGE-1 DELAY EXPERIMENTS

LaGuardia Airport

New York
Airport Improvement Task Force Delay Studies

Peat, Marwick, Mitchell & Co.
San Francisco, California

October 1978

TABLE B-1
LA GUARDIA DELAY EXPERIMENTS

Experiment Number	Model	Study Case ^a	Arrival Runways	Departure Runways	Weather	Demand	ATC System Scenario	Near-Term Improvements
Stage I Experiments								
1	ASM ^c	1	22	13	VFR1	1977	Today's	None
2	ASM	2	22	13	IFR1	1977	Today's	None
3	ASM	3	22	13	IFR2	1977	Today's	None
4	ASM	15	4	31	IFR2	1977	Today's	None
5	ASM	10	4	13	VFR1	1977	Today's	None
6	ASM	22	13	13	VFR1	1977	Today's	None
7	ASM	23	13	13	IFR1	1977	Today's	None
8	ASM	26	4	4	IFR1	1977	Today's	None ^d
9	ASM	20	13	4	IFR1	1977	Today's	None ^e
10	ASM	23	13	13	IFR1	1977	Today's	f
10A	ASM	23b	13	13	IFR1	1977	Today's	g
11	ASM	3	22	13	IFR2	1977	Today's	h
12	ASM	2	22	13	IFR1	1977	Today's	i
13	ASM	26	4	4	IFR1	1977	Today's	i
19	ASM	1	22	13	VFR1	1977	Today's	j
20	ASM	3	22	13	IFR2	1977	Today's	j
14	ADM	n.a.	n.a.	n.a.	n.a.	1977	Today's	None

- a. Study cases (combinations of runway use and weather conditions) and potential near-term improvements are identified in New York Airport Improvement Task Force Interim Report. The study cases are shown in Figure III-2. The potential improvements are identified in Appendix B.
- b. FAA will describe impact of post-1982 ATC systems on model inputs.
- c. Airfield Simulation Model.
- d. Task Force will establish packages of near-term improvements most likely to be implemented in pre-1982 and post-1982 time frames.
- e. Has improved airspace procedures and a high speed exit from Runway 13 to Taxiway O.
- f. Relocates Runway 13 glide slope antenna to reduce critical zone impact.
- g. Has LGA/TES interaction.
- h. Has ASDE.
- i. Has improved taxiway network, including partial parallel to Runway 4.
- j. Demand-delay relationship relating to impact of quota system alternatives.

TABLE B-2
LaGuardia Airport
INDEX OF STAGE 1 EXPERIMENTS^a

<u>Sequence No.</u>	<u>Experiment No.</u>	<u>Study Case No.</u>	<u>Model</u>	<u>Page</u>
1	1	1	ASM	49
2	19	1	ASM	52
3	2	2	ASM	55
4	3	3	ASM	58
5	11	3	ASM	61
6	20	3	ASM	64
7	4	15	ASM	67
8	5	16	ASM	70
9	6	22	ASM	73
10	7	23	ASM	76
11	10	23	ASM	79
12	10A	23b	ASM	82
13	8	26	ASM	85
14	9	20	ASM	88
15	14	n.a.	ADM	

a. Stage 1 experiments as presented in Table B-1 but reorganized and grouped by like runway configuration. Experiments 12 and 13 have been moved to Stage 2.

Table B-3

NEW YORK TASK FORCE DELAY STUDIES
LaGuardia Airport
Summary Results of Stage-1 Experiments
Airfield Simulation Model Runs

Experiment No.	Runways Used		Time Frame	Weather Conditions	Average Flow Rates		Average Runway Delays				Average Taxiing Delays				Major Comparison Case		
	Arrivals	Departures			Arrivals	Departures	Arrival Air	Departures	Taxi-In	Taxi-Out							
1	22	13	1977	VFR1	39	many	42	19-20	24.0	20:30	4.9	19:15	0.0	-	0.7	16:30	baseline 1, 9, 2, 3
19	22	13	1977	VFR1	39	18-19	40	19-20	9.2	18:15	3.5	19:15	0.1	17:15	0.6	16:30	1
2	22	13	1977	IFR1	30	many	34	18-19	90.8	20:30	1.0	19:15	0.0	-	0.4	17:00	baseline, 12
3	22	13	1977	IFR2	30	many	28	18-19	54.7	20:45	42.4	20:15	3.7	20:00	2.6	20:30	baseline, 11, 20
11	22	13	1977	IFR2	30	many	28	18-19	51.3	20:45	54.2	20:45	13.7	20:45	11.7	20:00	3
20	22	13	1977	IFR2	39	18-19	39	19-20	9.6	18:30	4.4	19:15	0.05	17:00	0.6	19:00	3
4	4	31	1977	IFR2	27	many	19	16-17	84.5	20:45	147.4	20:45	14.6	18:00	17.5	19:45	baseline
5	4	13	1977	VFR1	39	19-20	42	19-20	24.6	19:00	7.6	19:15	0.6	19:00	0.8	16:30	baseline
6	13	13	1977	VFR1	39	many	30	16-17	22.2	20:30	83.6	20:45	14.2	19:15	11.6	20:45	baseline 7, 10, 10A
7	13	13	1977	IFR1	28	many	33	17-18	107.4	20:30	4.3	19:00	0.0	-	0.4	17:00	baseline, 10, 10A
10	13	13	1977	IFR1	30	many	30	20-21	84.0	20:15	39.0	20:30	13.5	20:00	2.7	20:15	7
10A	13	13	1977	IFR1	9	19-20	24	15-16	240.6	20:30	0.9	17:15	0.04	17:00	0.3	15:45	7, 10
8	4	4	1977	IFR1	30	many	34	19-20	89.2	20:30	11.3	19:30	0.03	20:30	0.4	17:00	baseline, 13
9	13	4	1977	IFR1	27	many	29	many	114.7	20:45	24.4	19:30	5.6	19:15	4.2	19:00	7

LGA STAGE - 1 EXPERIMENTSExperiment No. 1Objective:

To provide baseline delay estimates, in VFRL conditions, for the following runway-use configuration:

<u>Arrival Runway</u>	<u>Departure Runways</u>
22	13

Related Comparison Experiments:

Experiment 19 has same runway-use configuration and weather conditions but a different aircraft mix, to reflect impact of quota system alternatives.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 1A shows that total aircraft flows vary from 53 to 80 aircraft per hour over the 6-hour simulation run. The peak hour is from 19:00 to 20:00 hours and contained 38 arrivals and 42 departures. Figures 1A and 1B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 22 aircraft per hour, which is 28 percent of the corresponding peak-hour total flow rate.

Figure 1B shows that average runway delays by 15-minute intervals to aircraft are as high as 24.0 minutes per aircraft. Peak hour average delays are 24.0 minutes for arrivals and 4.9 minutes for departures.

Figure 1C shows that the peak-period average delays to aircraft using the taxiways are 0.0 minutes for taxi-in and 0.7 minutes for taxi-out.

Figure 1D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 1A AVERAGE RUNWAY FLOW RATES

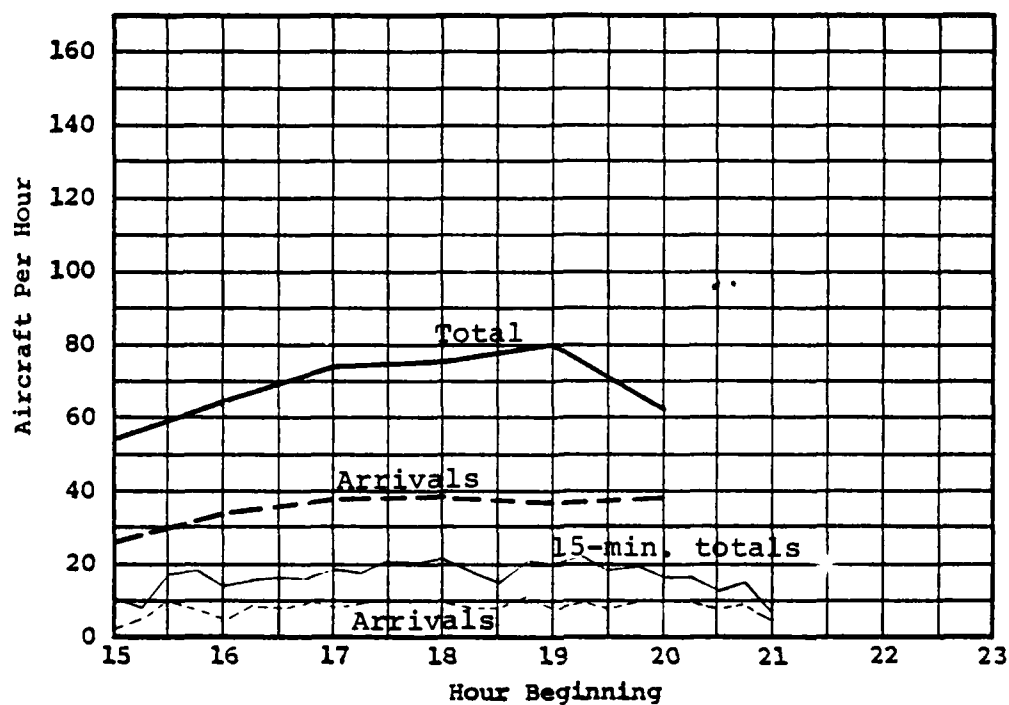


FIGURE 1B AVERAGE RUNWAY DELAYS

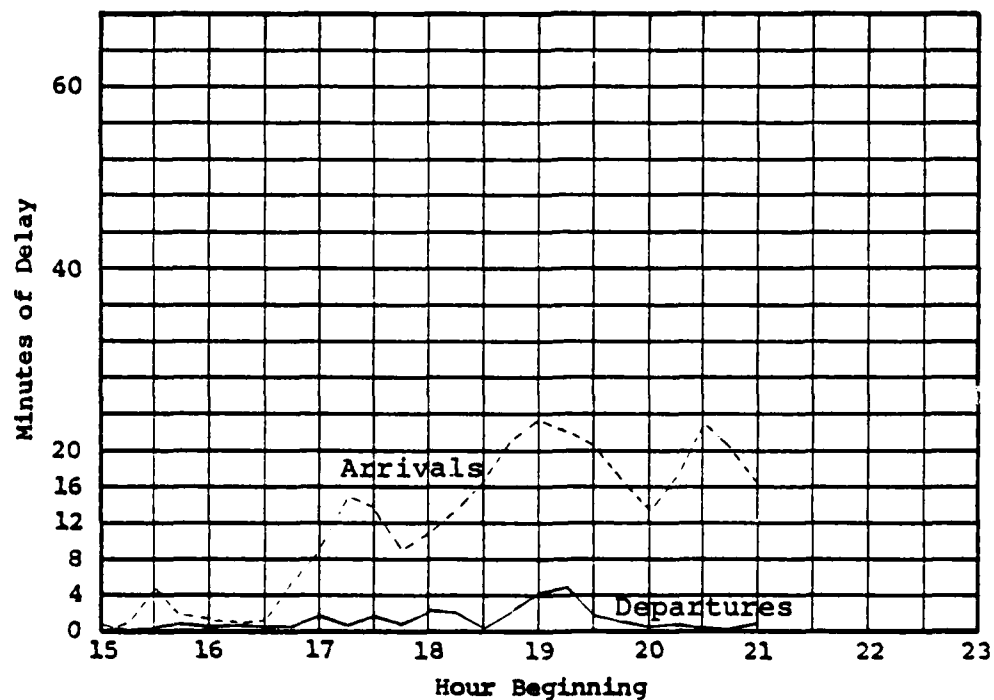


FIGURE 1C AVERAGE TAXIWAY DELAYS

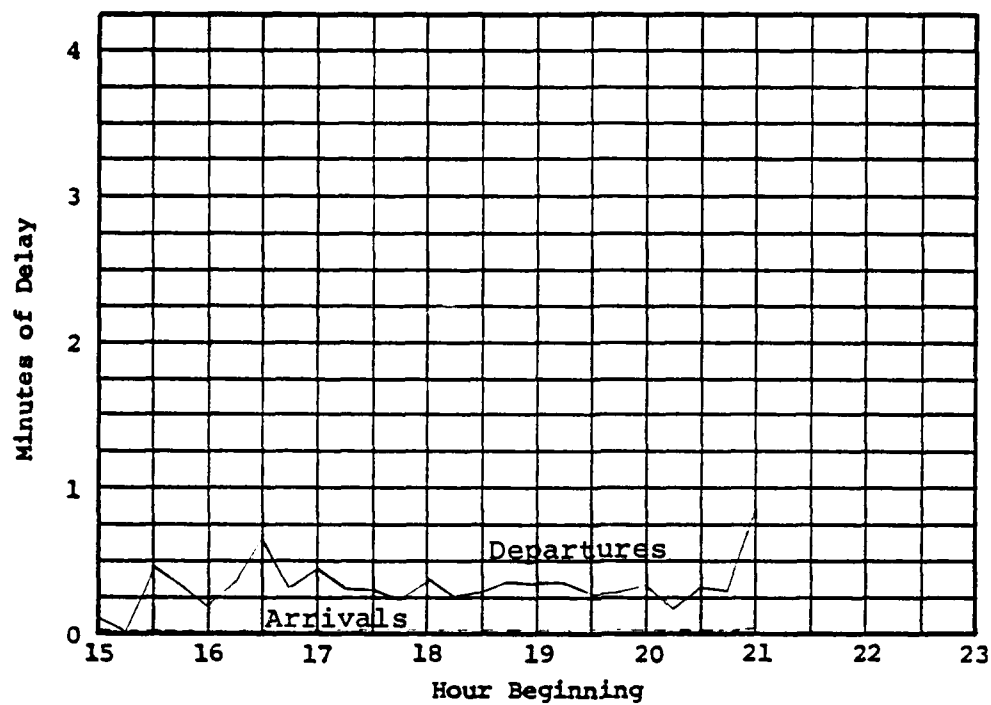
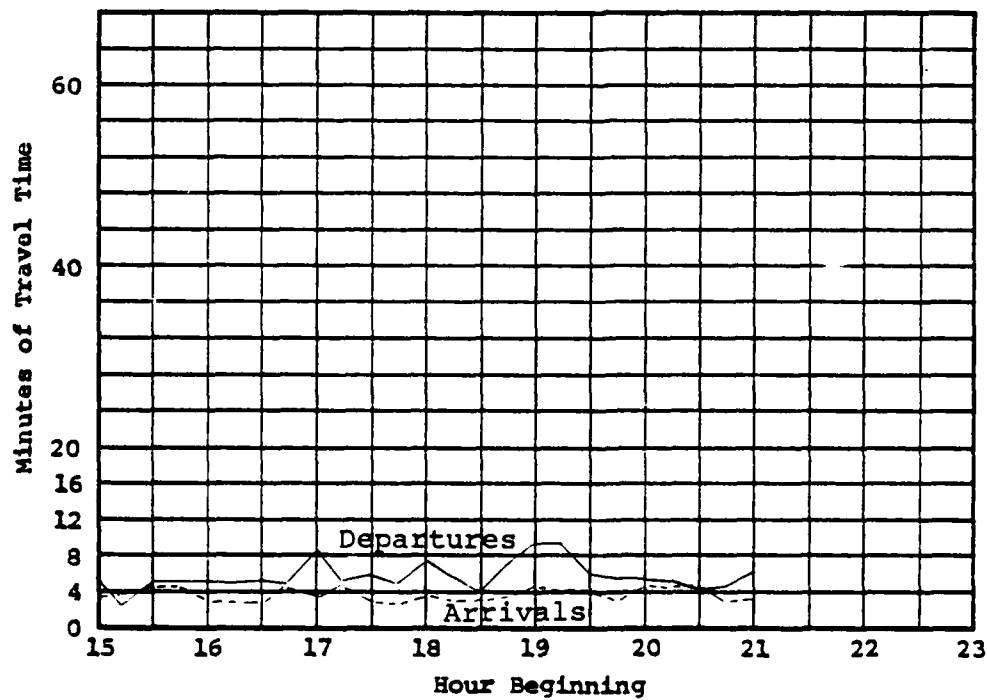


FIGURE 1D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE - 1 EXPERIMENTS

Experiment No. 19

Objective:

To evaluate the impact in VFR1 conditions of case-specific observed (1977) aircraft mix that differs from the FAR-93 mix used in the baseline capacity experiments.

Related Comparison Experiments:

The impact will be evaluated by comparison with results of Experiment No. 1.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Anticipated Results:

Lower delays than in Experiment 1 due to assumed enforcement of quota.

Results:

Figures 19A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation</u>	<u>Performance</u>		<u>This Experiment</u>		<u>Experiment No. 1</u>	
<u>Type</u>	<u>Measure*</u>	<u>Units</u>	<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	39	18-19	39	many
Arrival	Runway Delay	min.	9.2	18:15	24.0	20:30
Arrival	Taxi-In Delay	min.	0.1	17:15	0.0	-
Departure	Flow Rate	a/c per hr.	40	19-20	42	19-20
Departure	Runway Delay	min.	3.5	19:15	4.9	19:15
Departure	Taxi-Out Delay	min.	0.6	16:30	0.7	16:30

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 19A AVERAGE RUNWAY FLOW RATES

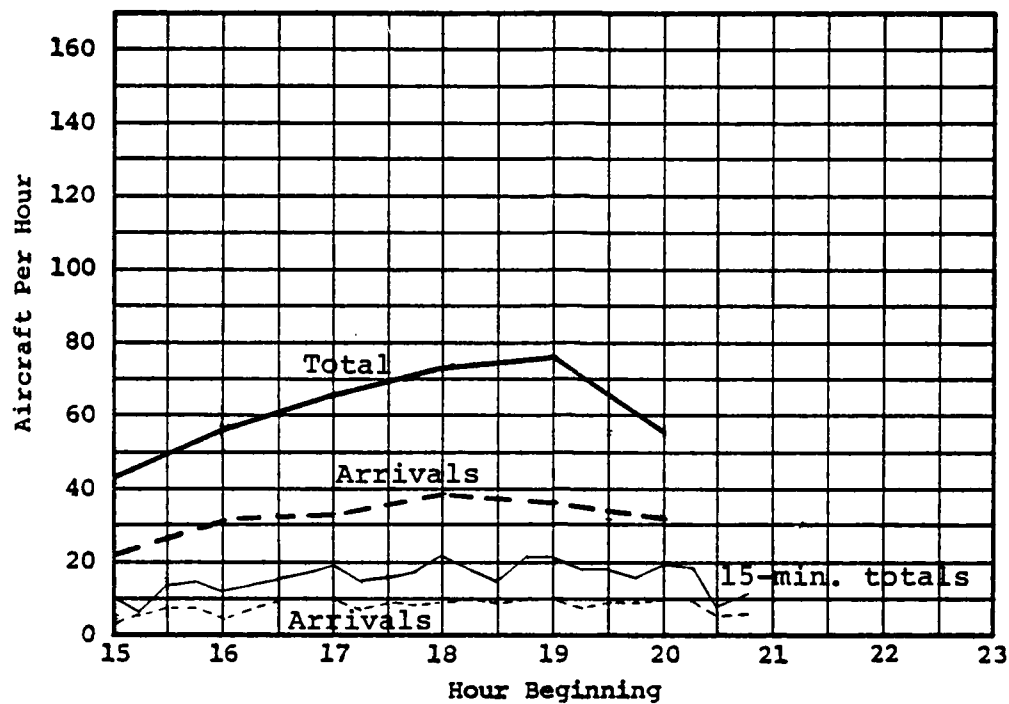


FIGURE 19B AVERAGE RUNWAY DELAYS

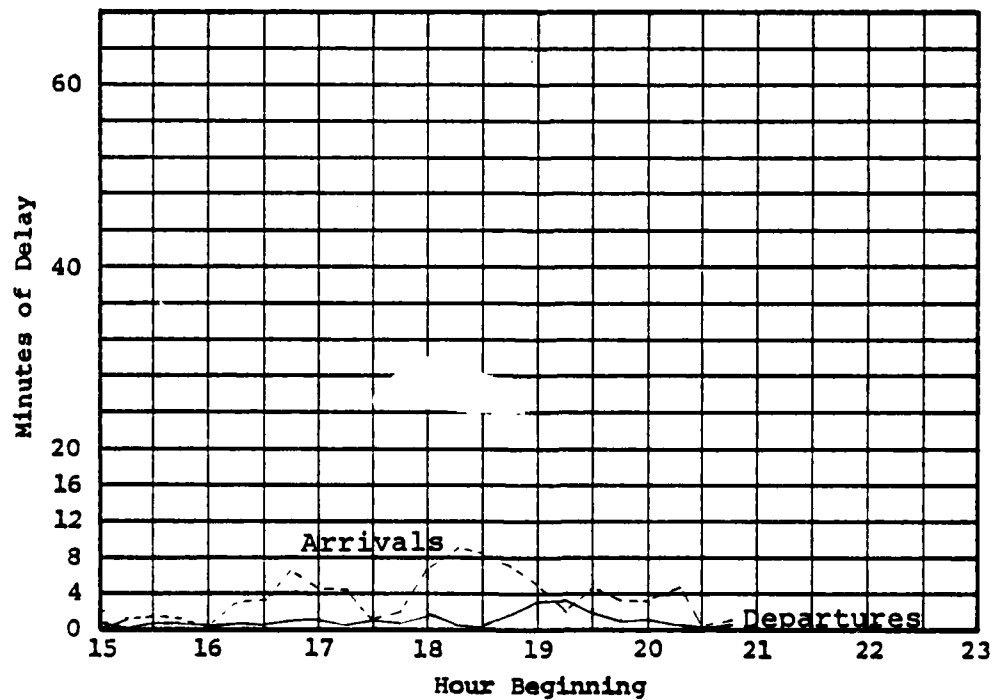


FIGURE 19C AVERAGE TAXIWAY DELAYS

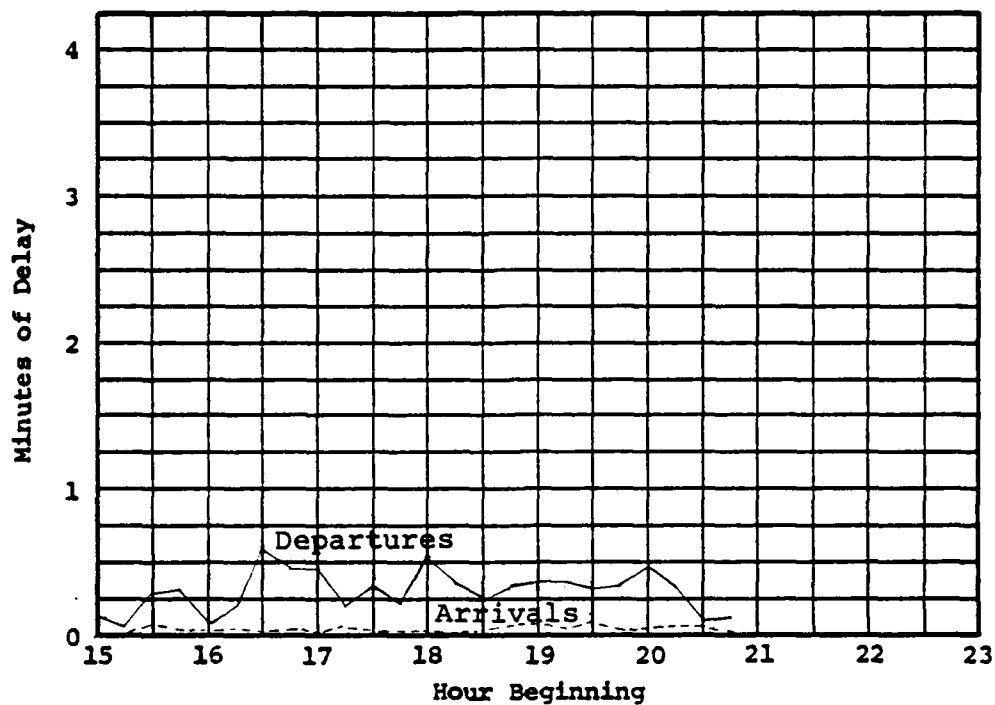
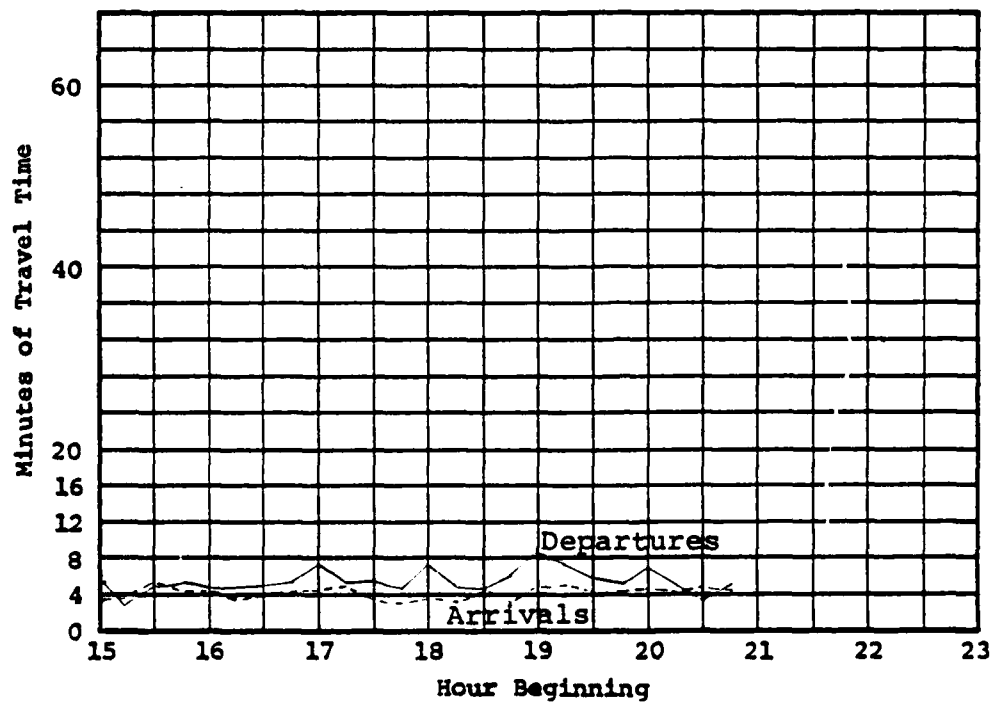


FIGURE 19D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE - 1 EXPERIMENTSExperiment No. 2Objective:

To obtain baseline delay estimates in IFR1 weather conditions, for the following runway-use configuration:

<u>Arrival Runways</u>	<u>Departure Runways</u>
22	13

Related Comparison Experiments:

Experiment No. 12 is for the same runway-use and weather, but it involves an improved taxiway network west of R4/22 and a partial parallel to Runway 4.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 2A shows that total aircraft flows vary from 47 to 64 aircraft per hour over the 6-hour simulation run. The peak hour is from 17:00 to 18:00 hours and contained 29 arrivals and 35 departures. Figures 2A and 2B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 18 aircraft per hour, which is 29 percent of the corresponding peak-hour total flow rate.

Figure 2B shows that average runway delays by 15-minute intervals to aircraft are as high as 90.8 minutes per aircraft. Peak hour average delays are 86.7 minutes for arrivals and 0.9 minutes for departures.

Figure 2C shows that the peak-period average delays to aircraft using the taxiways are 0.0 minutes for taxi-in and 0.4 minutes for taxi-out.

Figure 2D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 2A AVERAGE RUNWAY FLOW RATES

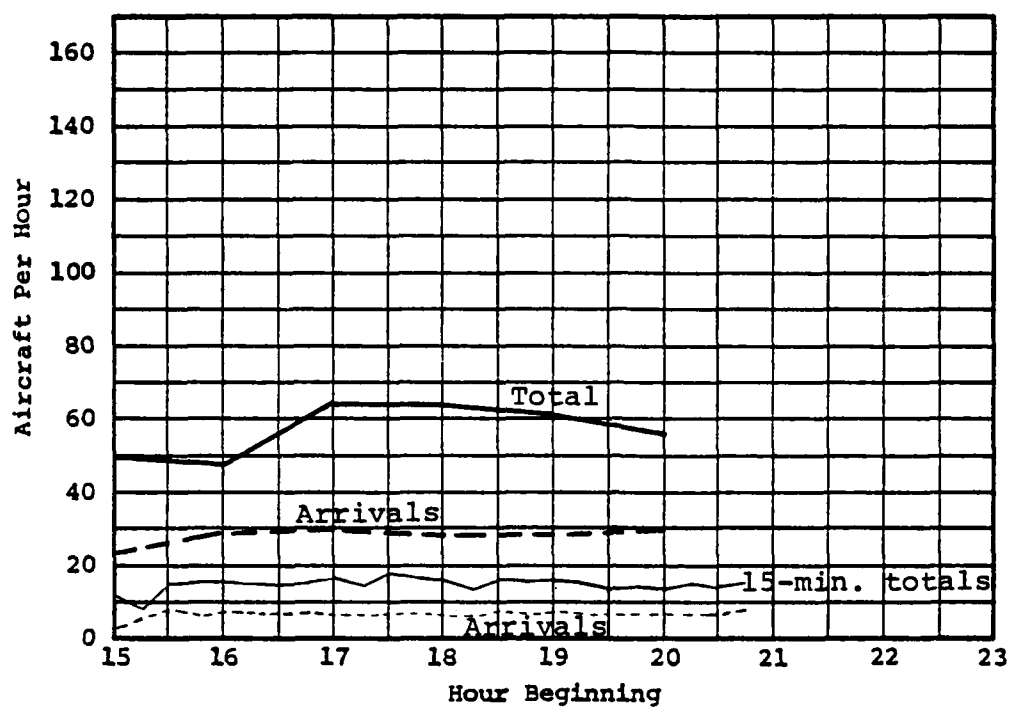


FIGURE 2B AVERAGE RUNWAY DELAYS

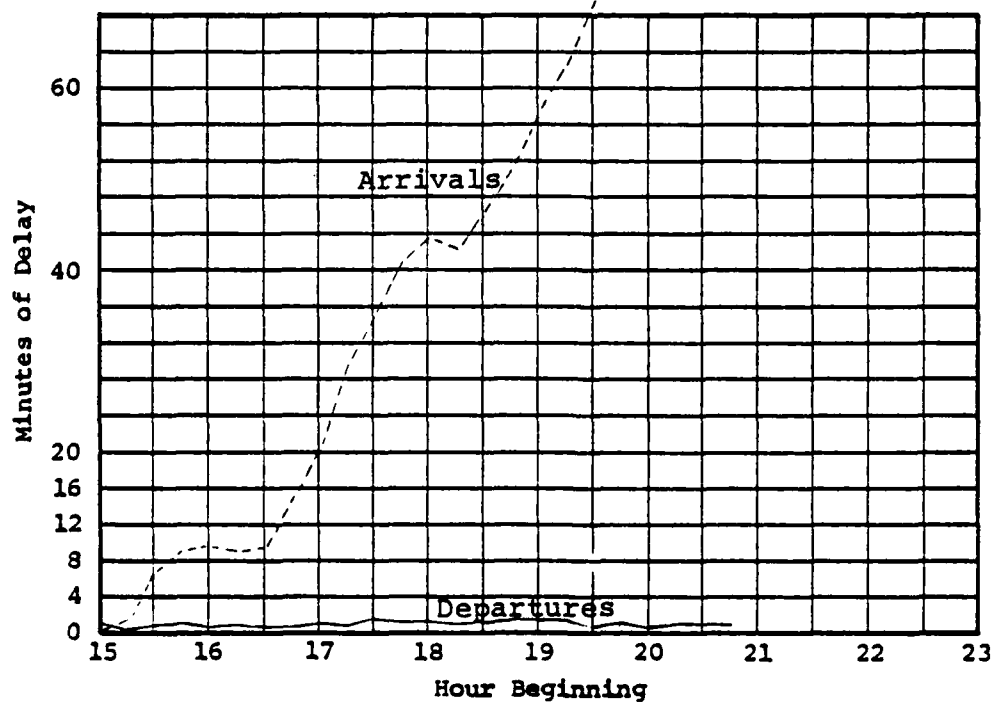


FIGURE 2C AVERAGE TAXIWAY DELAYS

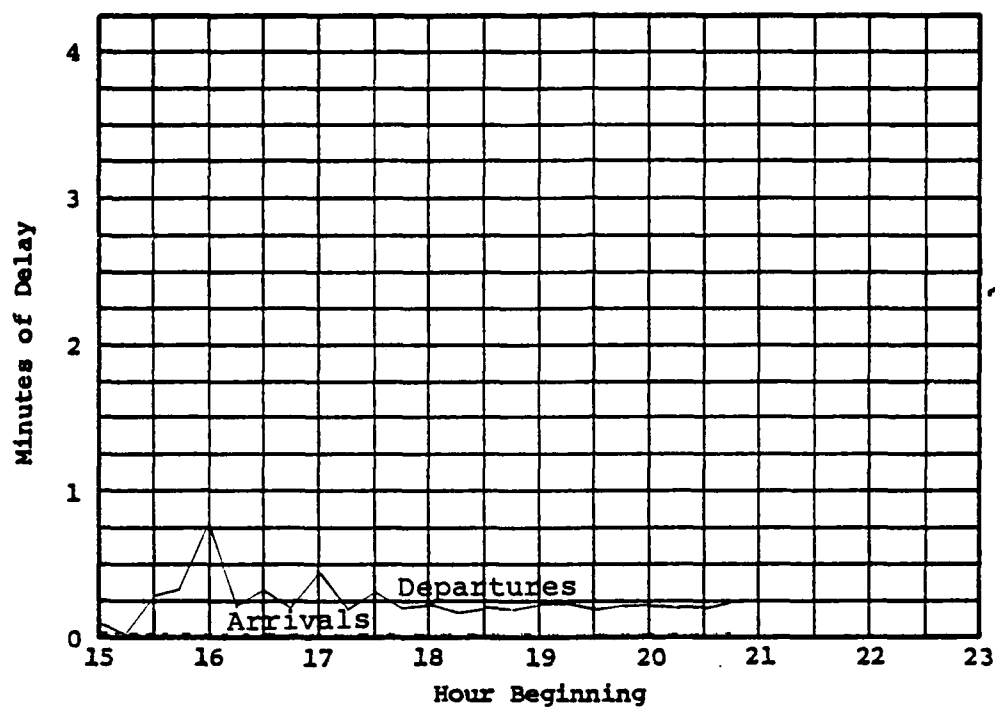
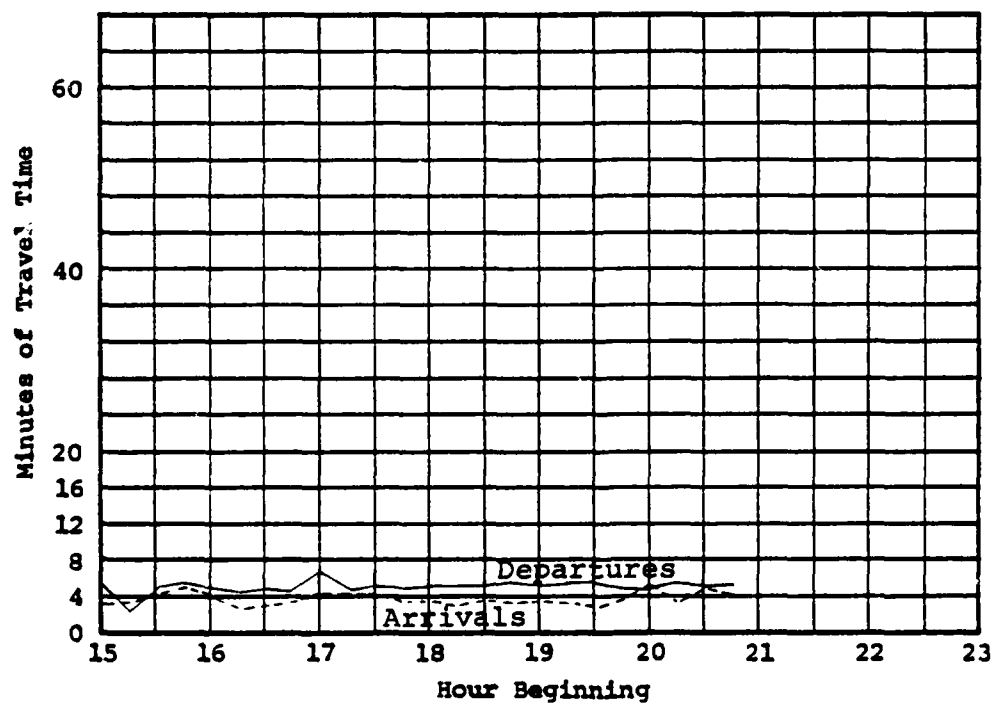


FIGURE 2D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE - 1 EXPERIMENTSExperiment No. 3Objective:

To obtain baseline delay estimates, in IFR2 weather conditions, for the following runway-use configurations:

<u>Arrival Runways</u>	<u>Departure Runways</u>
22	13

Related Comparison Experiments:

Experiments 11 and 20 have same conditions.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 3A shows that total aircraft flows vary from 23 to 30 aircraft per hour over the 6-hour simulation run. The peak hour is from 18:00 to 19:00 hours and contained 30 arrivals and 28 departures. Figures 3A and 3B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 15 aircraft per hour, which is 26 percent of the corresponding peak-hour total flow rate.

Figure 3B shows that average runway delays by 15-minute intervals to aircraft are as high as 54.7 minutes per aircraft. Peak hour average delays are 50.4 minutes for arrivals and 34.0 minutes for departures.

Figure 3C shows that the peak-period average delays to aircraft using the taxiways are 3.7 minutes for taxi-in and 2.6 minutes for taxi-out.

Figure 3D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 3A AVERAGE RUNWAY FLOW RATES

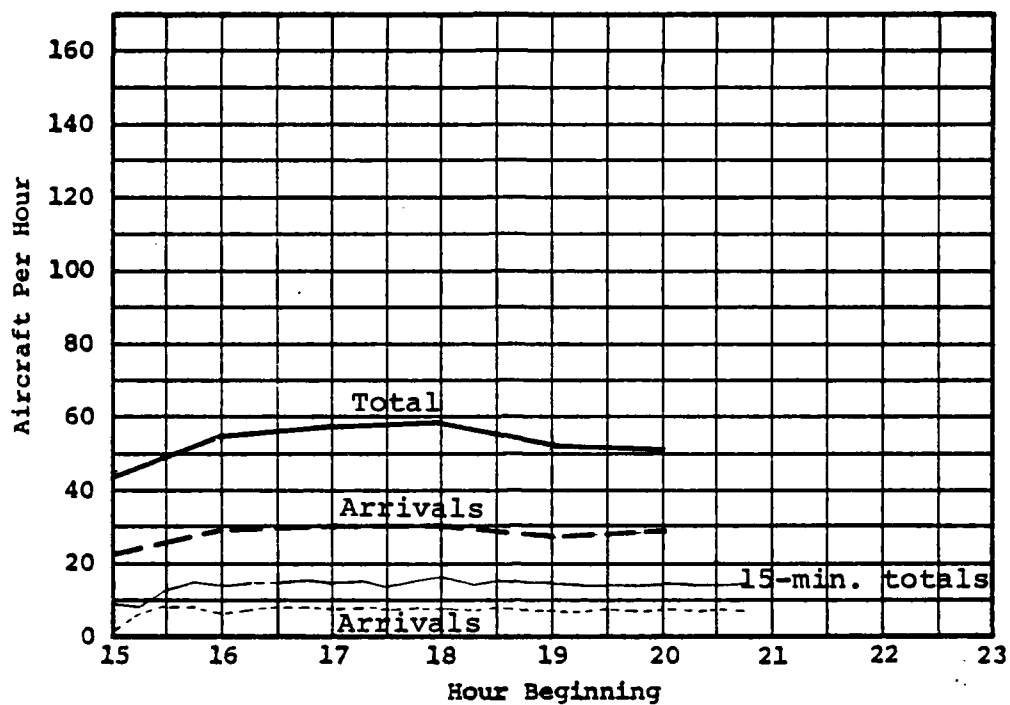


FIGURE 3B AVERAGE RUNWAY DELAYS

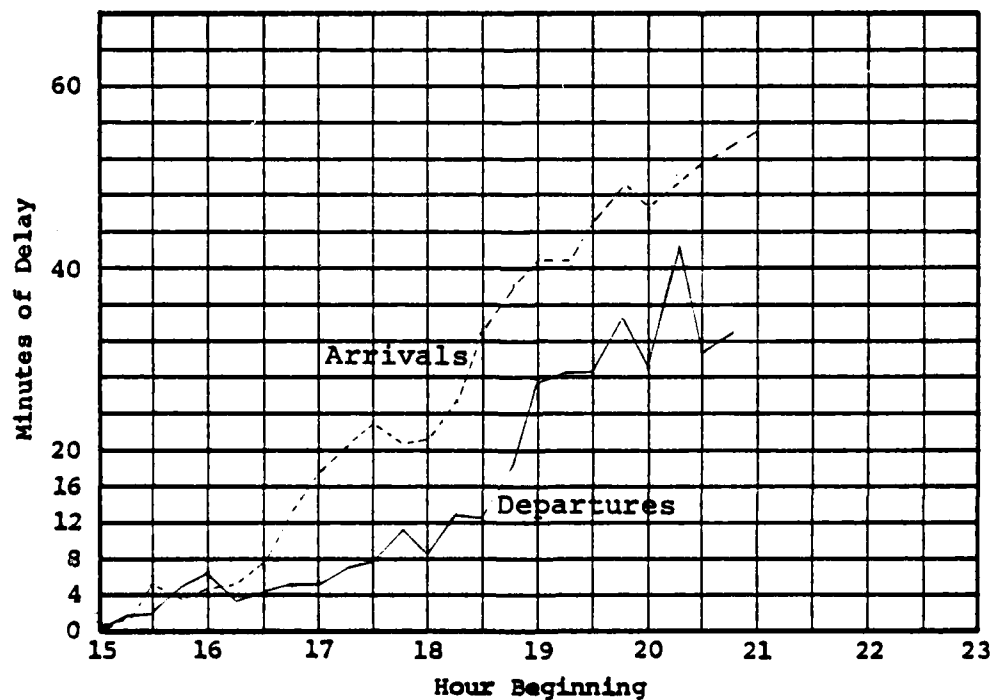


FIGURE 3C AVERAGE TAXIWAY DELAYS

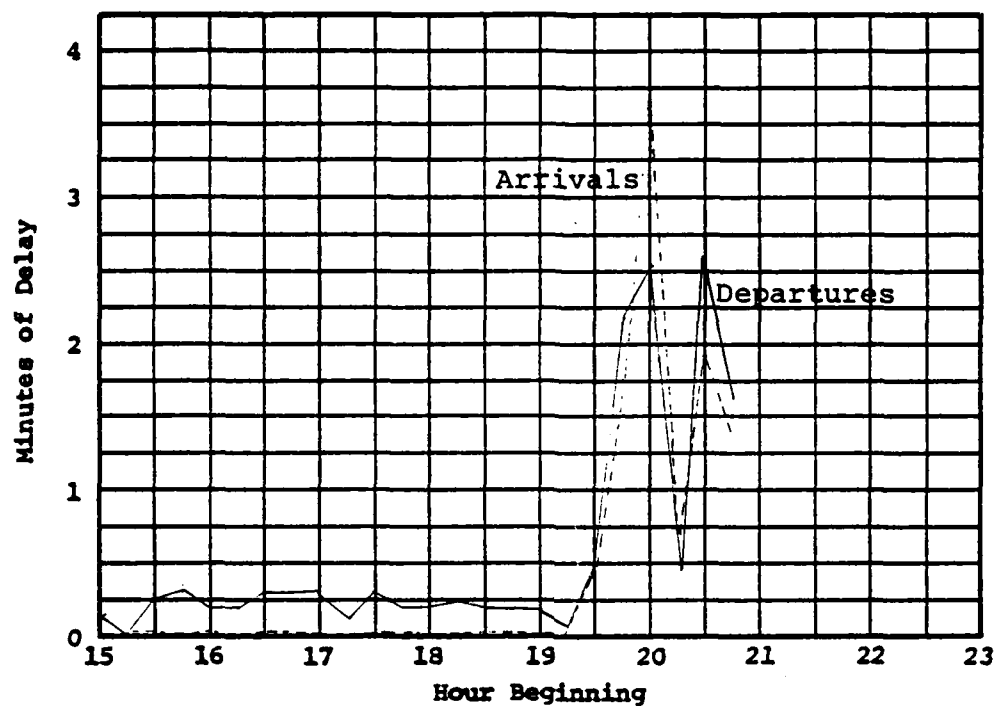
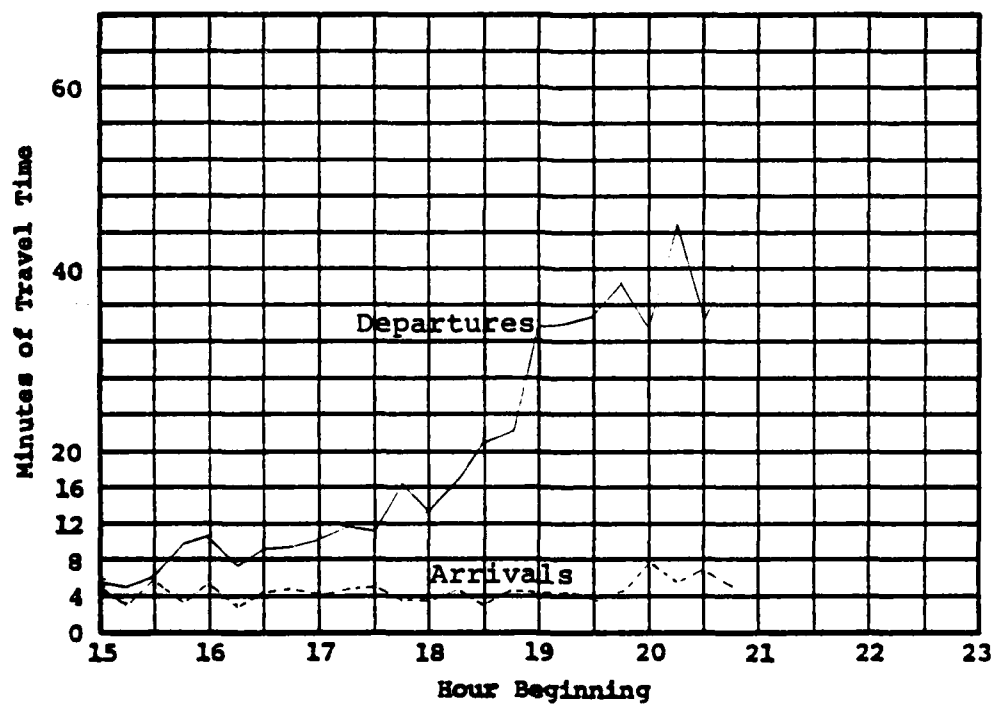


FIGURE 3D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE - 1 EXPERIMENTS

Experiment No. 11

Objective:

To evaluate effect of ASDE on delay estimates for IFR2 conditions.

Related Comparison Experiments:

Experiment 3 has the same conditions but with no ASDE-II improvement.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Anticipated Results:

Slightly increased flow rates and reduced delays than in Experiment 3 due to ASDE-II.

Results:

Figures 11A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment Peak</u>	<u>Time</u>	<u>Experiment No. 3 Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	30	many	30	many
Arrival	Runway Delay	min.	51.3	20:45	90.8	20:30
Arrival	Taxi-In Delay	min.	13.7	20:45	0.0	-
Departure	Flow Rate	a/c per hr.	28	18-19	34	18-19
Departure	Runway Delay	min.	54.2	20:45	42.4	20:15
Departure	Taxi-Out Delay	min.	11.7	20:00	0.4	17:00

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 11A AVERAGE RUNWAY FLOW RATES

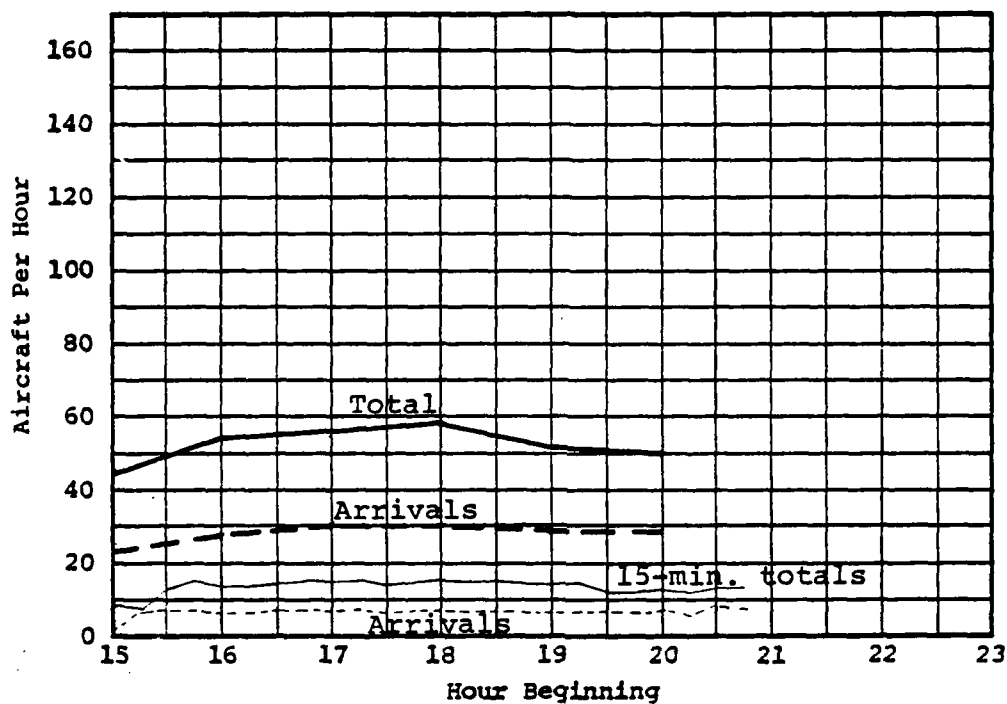


FIGURE 11B AVERAGE RUNWAY DELAYS

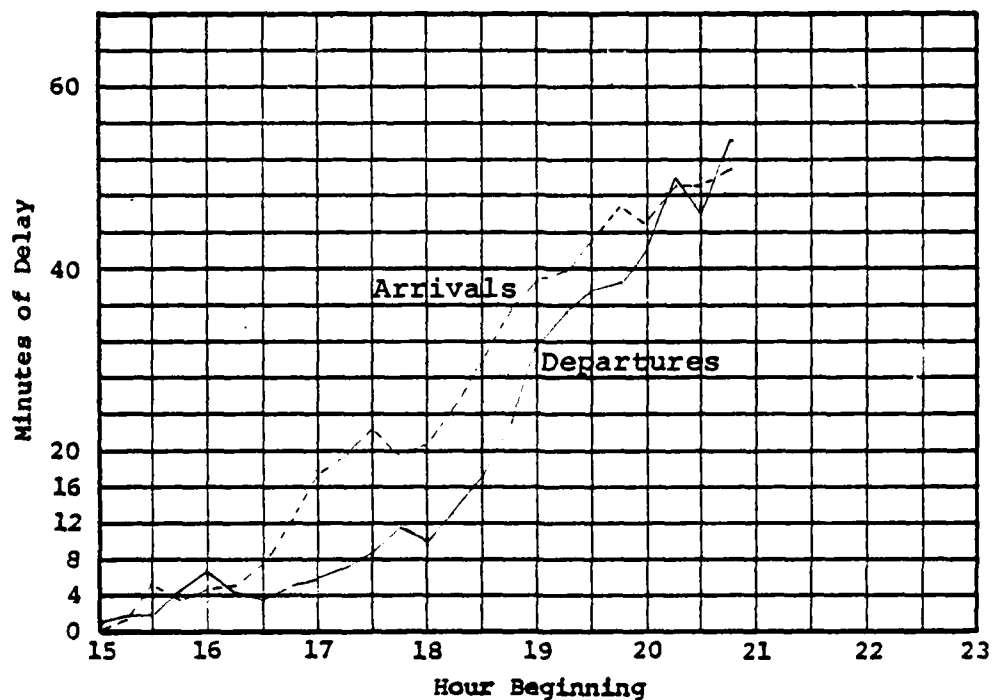


FIGURE 11C AVERAGE TAXIWAY DELAYS

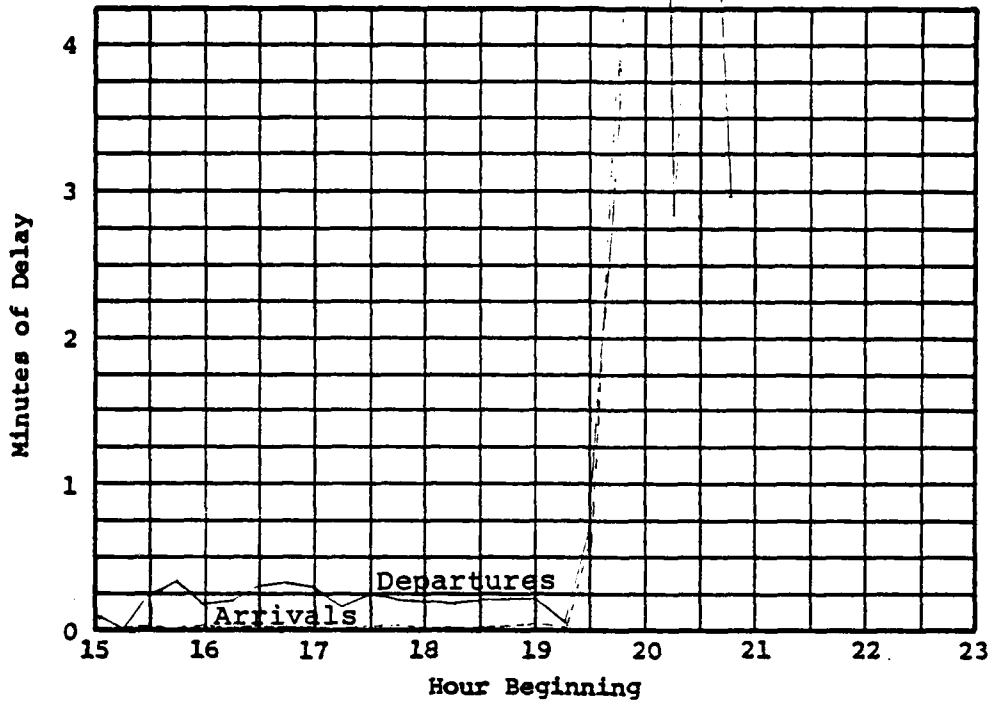
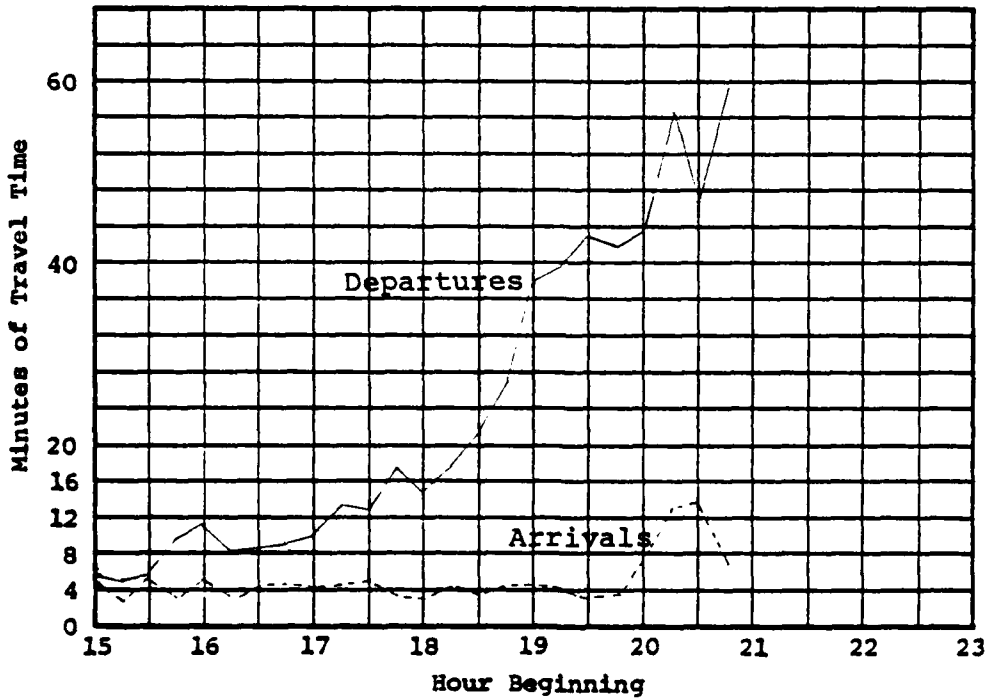


FIGURE 11D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE - 1 EXPERIMENTS

Experiment No. 20

Objective:

To evaluate effect of quota mix in IFR2 conditions -- see Experiment No. 19.

Related Comparison Experiments:

Experiment 3 is the baseline case; Experiment 19 is similar but in VFR1 conditions.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Anticipated Results:

Reduced delays compared with Experiment 3 due to assumed enforcement of quota.

Results:

Figures 20A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment Peak</u>	<u>Time</u>	<u>Experiment No. 3 Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	39	18-19	30	many
Arrival	Runway Delay	min.	9.6	18:30	90.8	20:30
Arrival	Taxi-In Delay	min.	0.05	17:00	0.0	-
Departure	Flow Rate	a/c per hr.	39	19-20	34	18-19
Departure	Runway Delay	min.	4.4	19:15	42.4	20:15
Departure	Taxi-Out Delay	min.	0.6	19:00	0.4	17:00

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 20A AVERAGE RUNWAY FLOW RATES

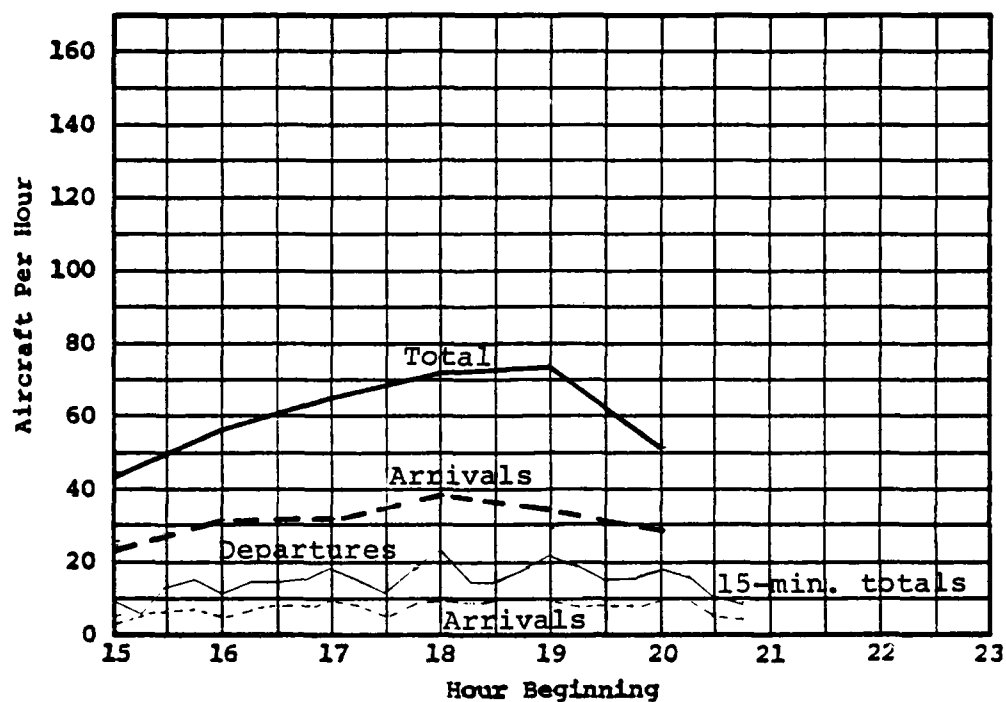


FIGURE 20B AVERAGE RUNWAY DELAYS

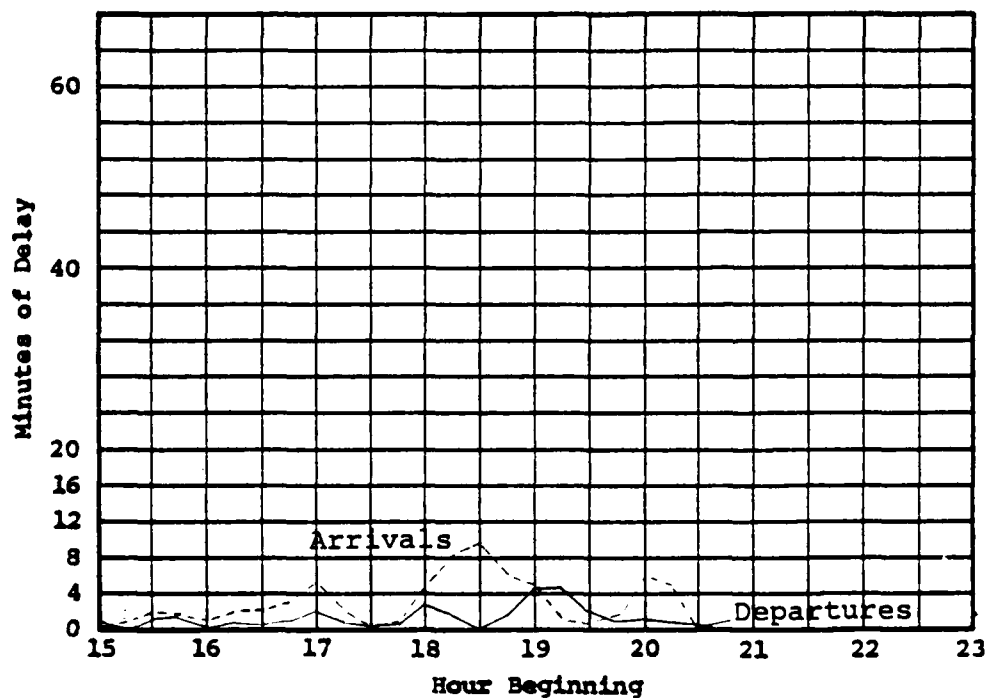


FIGURE 20C AVERAGE TAXIWAY DELAYS

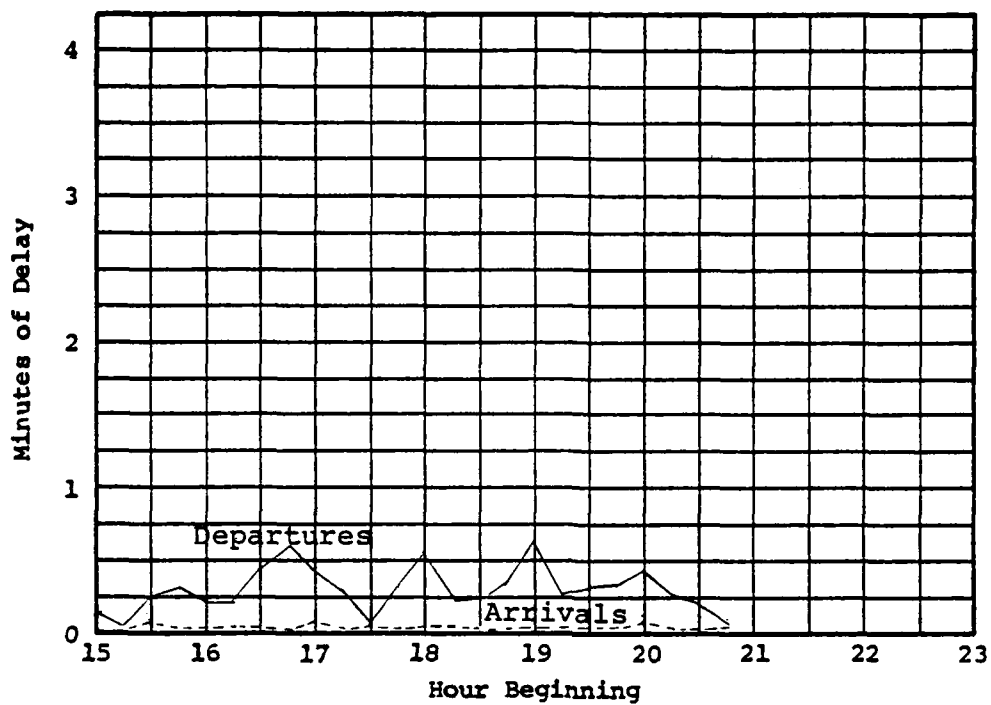
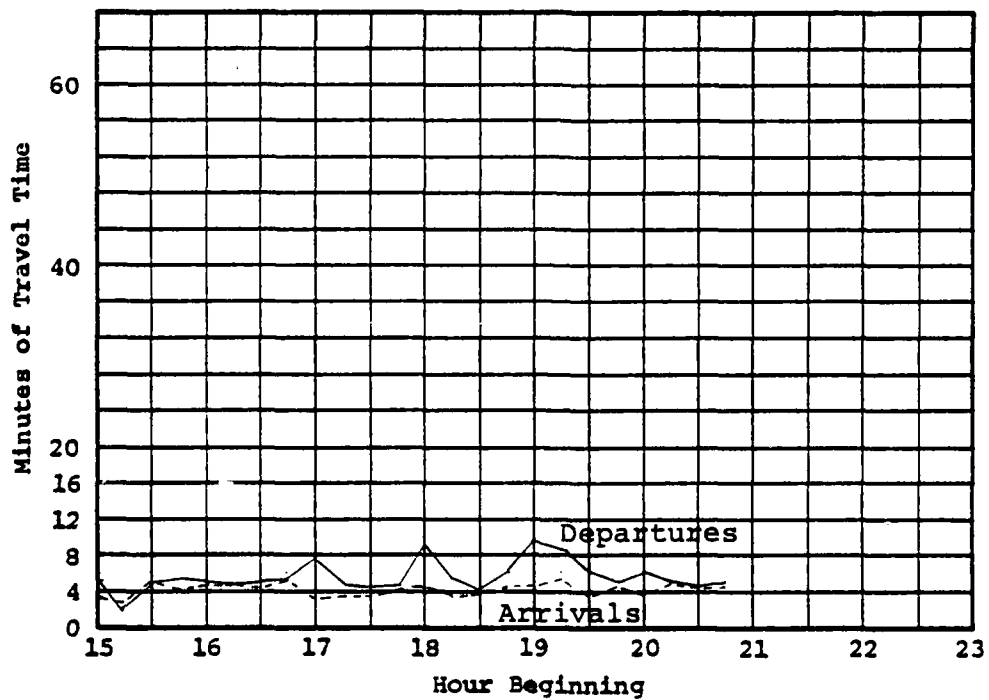


FIGURE 20D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE 1 EXPERIMENTSExperiment No. 4Objective:

To obtain baseline delay estimates, in IFR2 conditions, for the following runway-use configuration:

<u>Arrival Runways</u>	<u>Departure Runways</u>
4	31

Related Comparison Experiments:

None in Stage-1; possible Stage-2 experiment.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 4A shows that total aircraft flows vary from 35 to 45 aircraft per hour over the 6-hour simulation run. The peak hour is from 16:00 to 17:00 hours and contained 26 arrivals and 19 departures. Figures 4A and 4B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 13 aircraft per hour, which is 29 percent of the corresponding peak-hour total flow rate.

Figure 4B shows that average runway delays by 15-minute intervals to aircraft are as high as 147.4 minutes per aircraft. Peak hour average delays are 84.5 minutes for arrivals and 147.4 minutes for departures.

Figure 4C shows that the peak-period average delays to aircraft using the taxiways are 14.6 minutes for Taxi-in and 14.7 minutes for taxi-out.

Figure 4D shows the average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 4A AVERAGE RUNWAY FLOW RATES

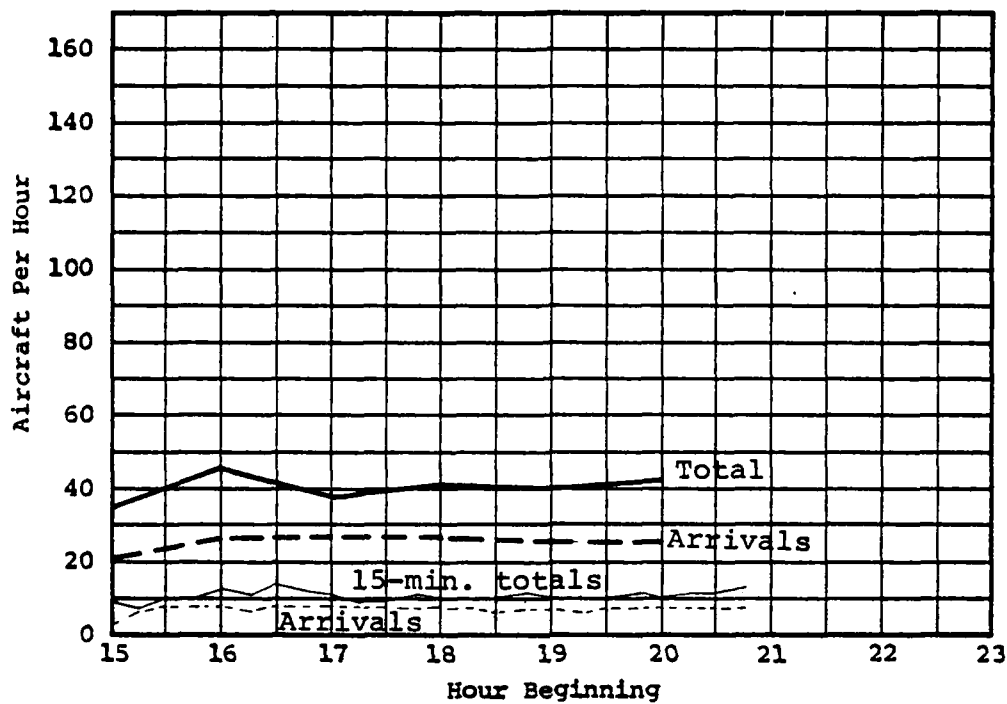


FIGURE 4B AVERAGE RUNWAY DELAYS

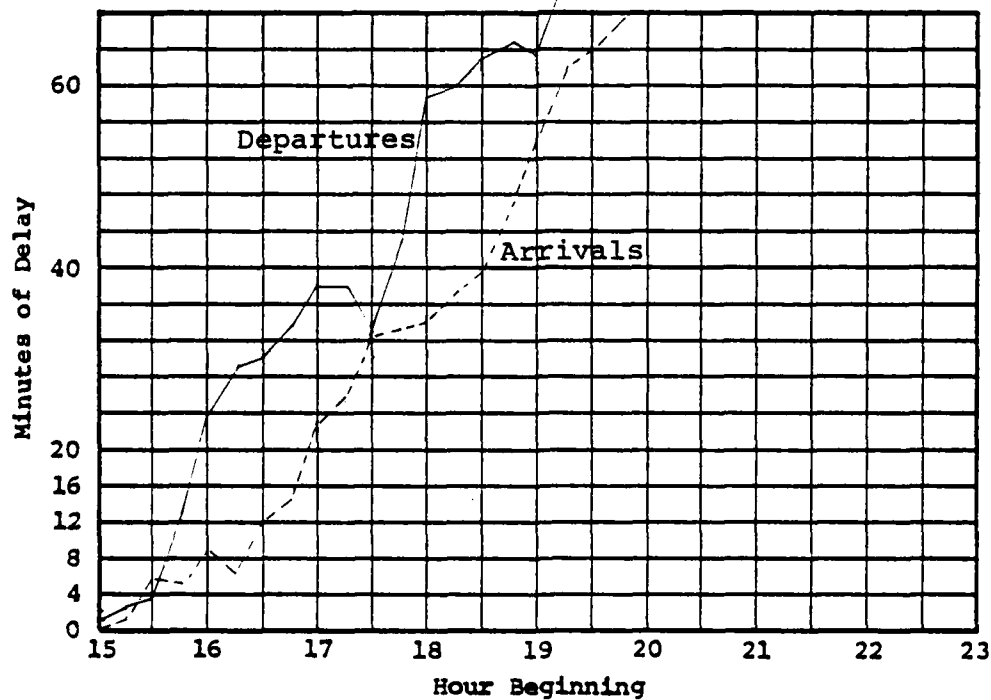


FIGURE 4C AVERAGE TAXIWAY DELAYS

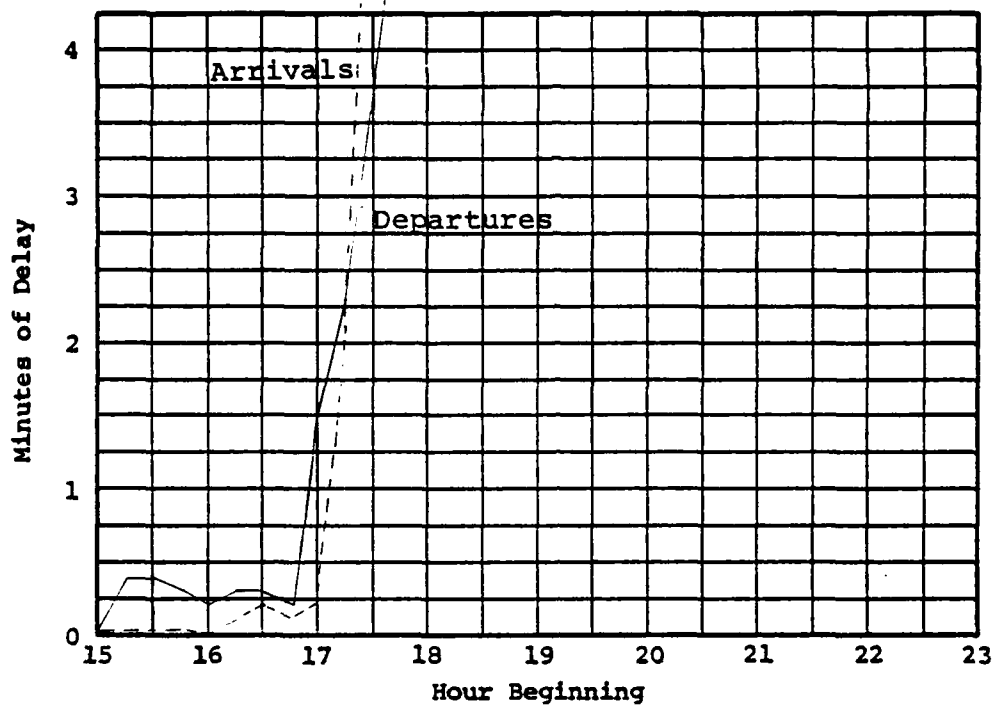
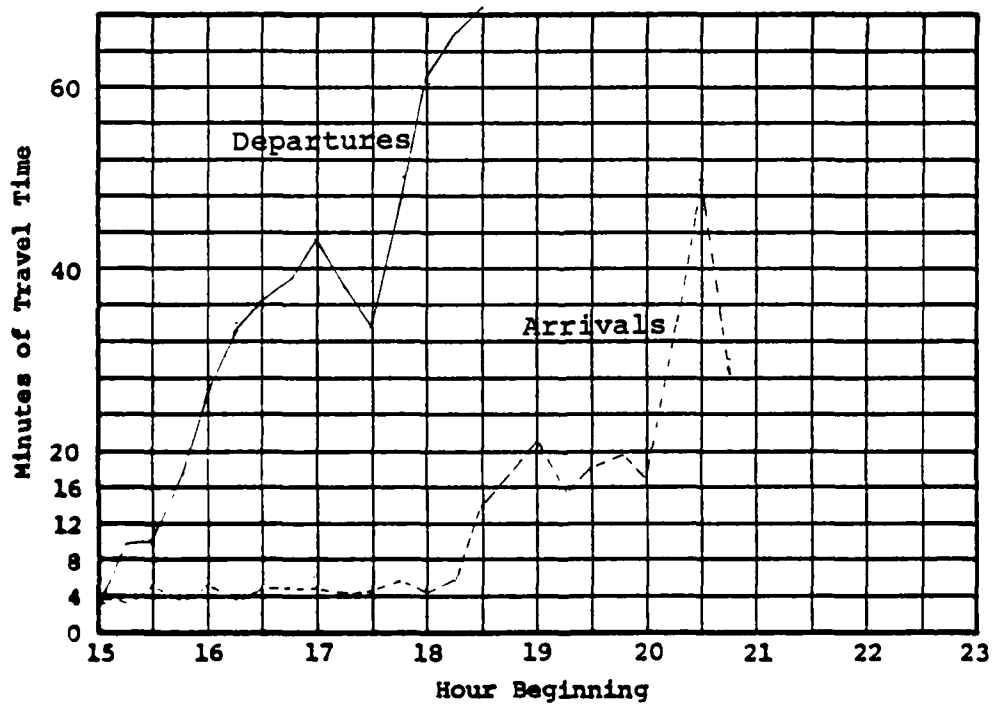


FIGURE 4D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE - 1 EXPERIMENTS

Experiment No. 5

Objective:

To obtain baseline delay estimates, in VFR1 conditions, for the following runway-use configuration:

<u>Arrival Runways</u>	<u>Departure Runways</u>
------------------------	--------------------------

4

13

Related Comparison Experiments:

None directly in Stage-1; possible in Stage-2.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 5A shows that total aircraft flows vary from 27 to 39 aircraft per hour over the 6-hour simulation run. The peak hour is from 19:00 to 20:00 hours and contained 39 arrivals and 42 departures. Figures 5A and 5B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 22 aircraft per hour, which is 27 percent of the corresponding peak-hour total flow rate.

Figure 5B shows that average runway delays by 15-minute intervals to aircraft are as high as 24.6 minutes per aircraft. Peak hour average delays are 221 minutes for arrivals and 53 minutes for departures.

Figure 5C shows that the peak-period average delays to aircraft using the taxiways are 0.6 minutes for taxi-in and 0.8 minutes for taxi-out.

Figure 5D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 5A AVERAGE RUNWAY FLOW RATES

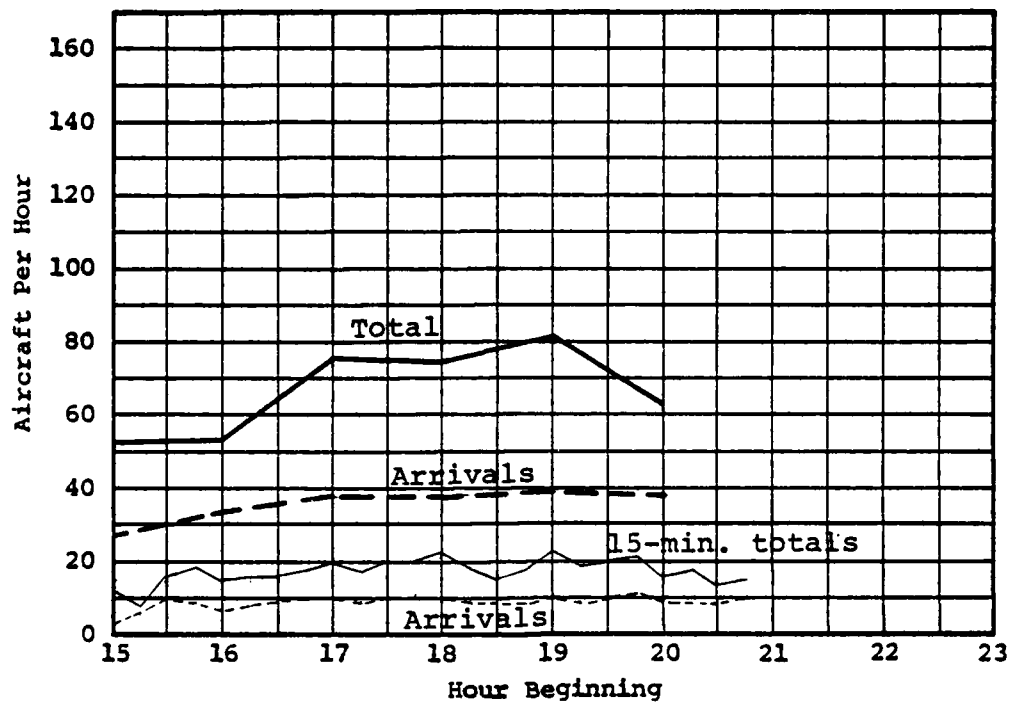


FIGURE 5B AVERAGE RUNWAY DELAYS

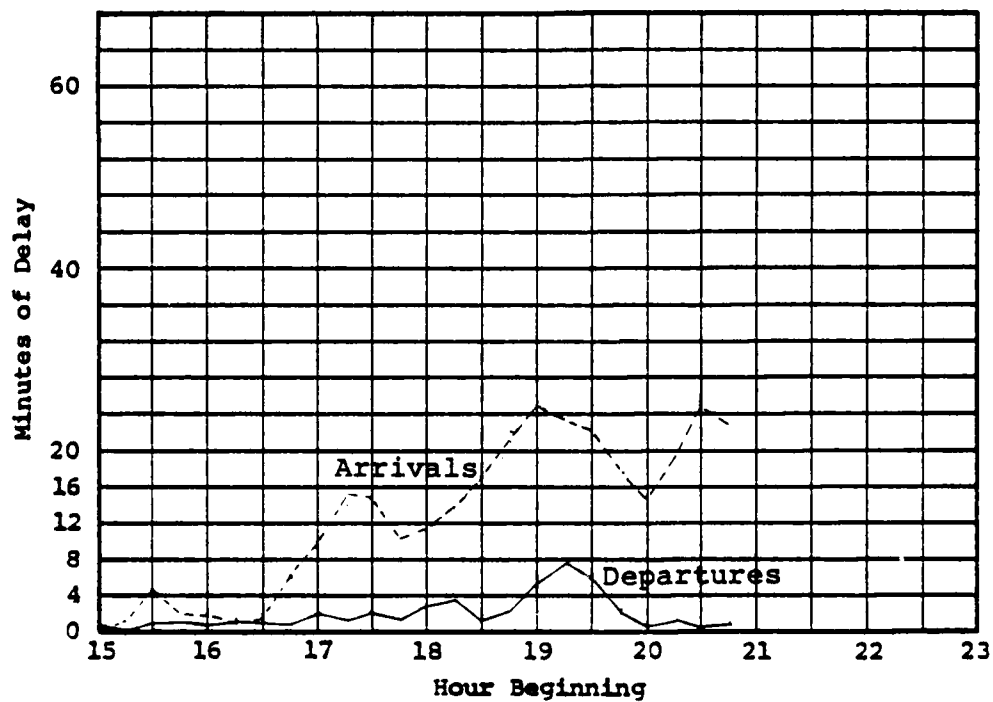


FIGURE 5C AVERAGE TAXIWAY DELAYS

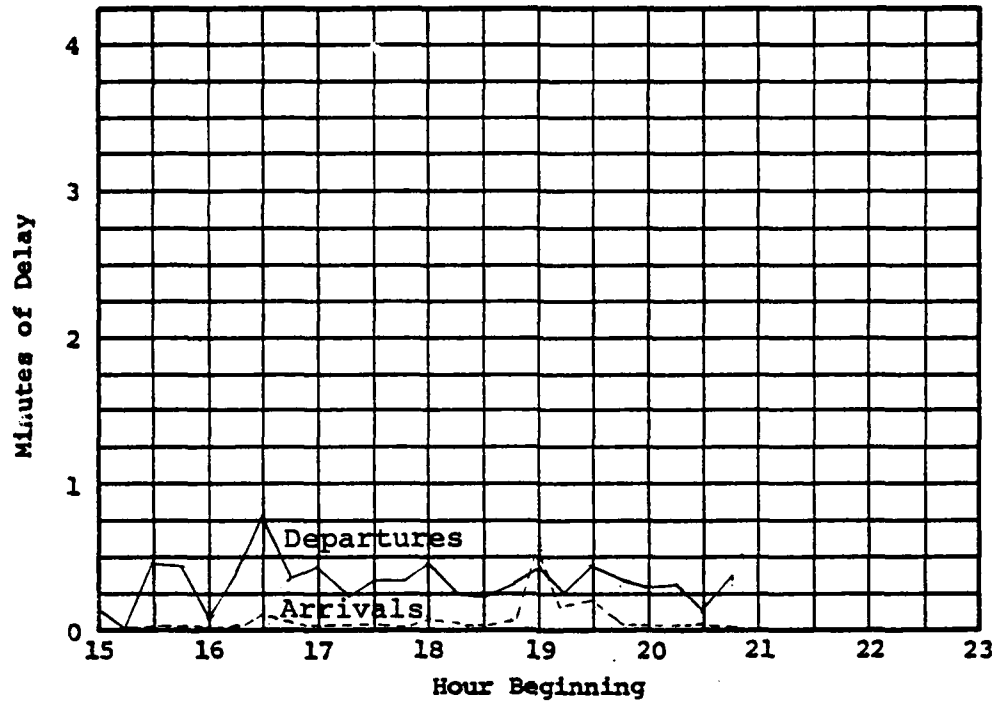
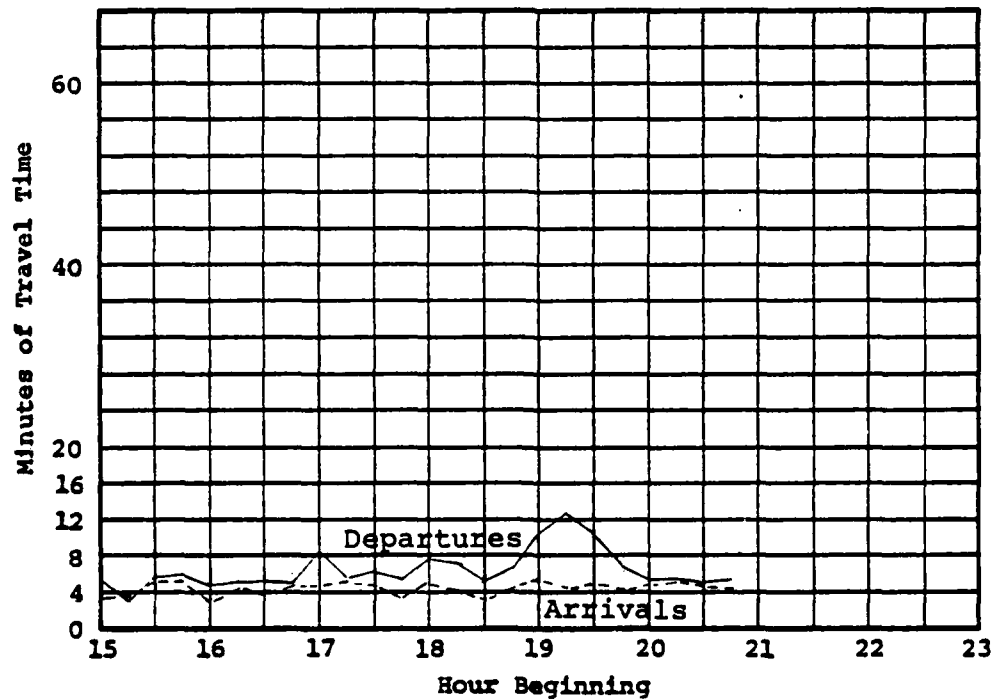


FIGURE 5D AVERAGE TAXIWAY TRAVEL TIMES



LGA STAGE - 1 EXPERIMENTSExperiment No. 6Objective:

To obtain baseline delay estimates, in VFR1 conditions, for the following runway-use configurations:

<u>Arrival Runways</u>	<u>Departure Runways</u>
13	13

Related Comparison Experiments:

Experiments 7, 10, and 10A have the same runway-use, but they have different weather, namely IFR1, and improvements.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 6A shows that total aircraft flows vary from 49 to 67 aircraft per hour over the 6-hour simulation run. The peak hour is from 19:00 to 20:00 hours and contained 39 arrivals and 28 departures. Figures 6A and 6B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 18 aircraft per hour, which is 27 percent of the corresponding peak-hour total flow rate.

Figure 6B shows that average runway delays by 15-minute intervals to aircraft are as high as 83.6 minutes per aircraft. Peak hour average delays are 22.2 minutes for arrivals and 83.6 minutes for departures.

Figure 6C shows that the peak-period average delays to aircraft using the taxiways are 14.2 minutes for taxi-in and 11.6 minutes for taxi-out.

Figure 6D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 6A AVERAGE RUNWAY FLOW RATES

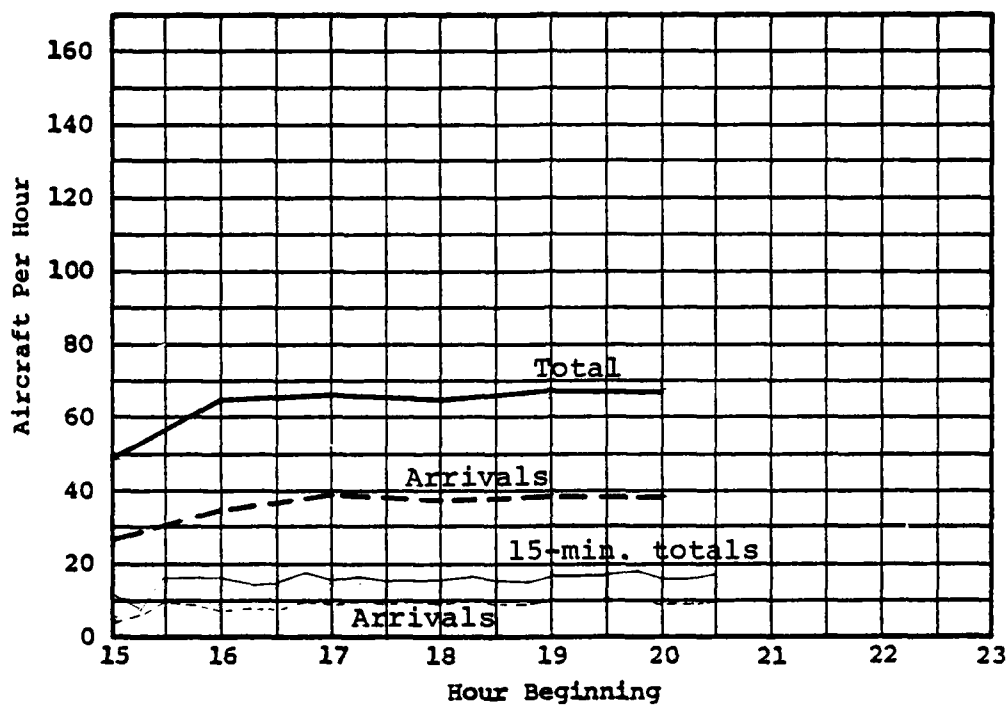


FIGURE 6B AVERAGE RUNWAY DELAYS

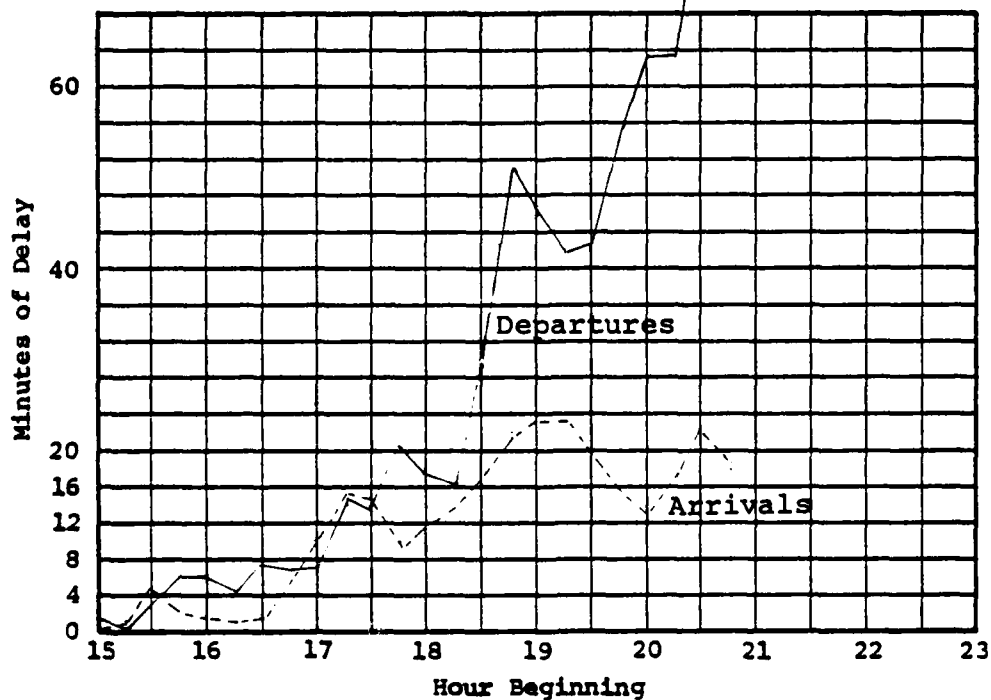


FIGURE 6C AVERAGE TAXIWAY DELAYS

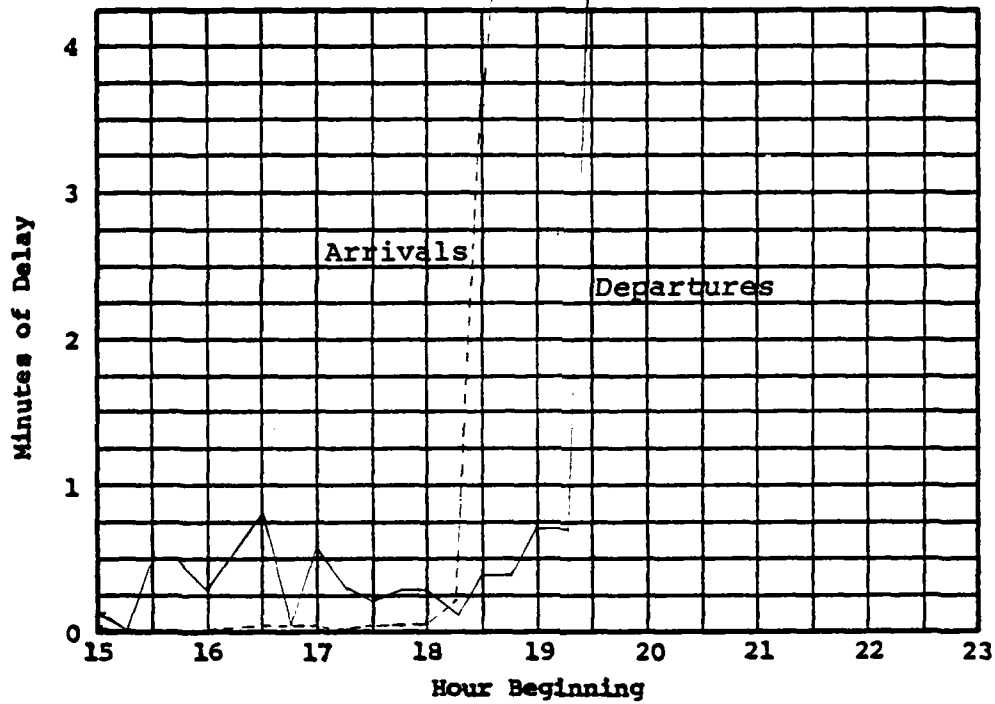
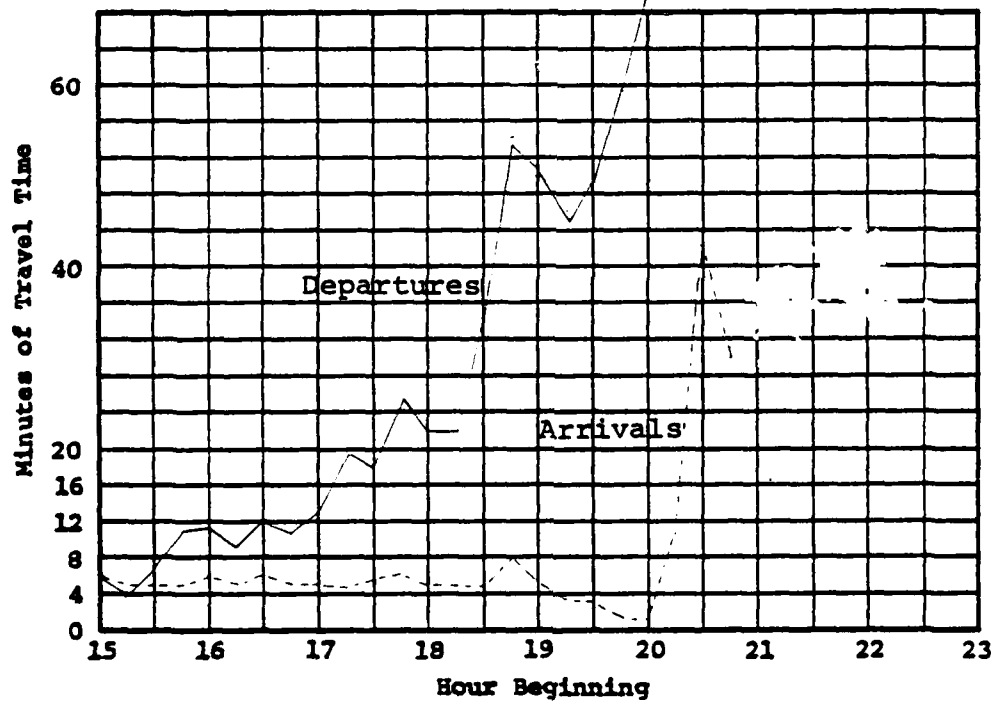


FIGURE 6D AVERAGE TAXIWAY TRAVEL TIMES



LGA - STAGE 1Experiment No. 7Objective:

To obtain baseline delay estimates in IFR1 conditions for the following runway-use configuration and no interaction with TEB:

<u>Arrivals</u>	<u>Departures</u>
13	13

Related Comparison Experiments:

Experiments 10 and 10A have same runway use and weather, but they involve improvements.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 7A shows that total aircraft flows vary from 48 to 61 aircraft per hour over the 6-hour simulation run. The peak hour is from 17:00 to 18:00 hours and contained 28 arrivals and 33 departures. Figures 7A and 7B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 17 aircraft per hour, which is 28 percent of the corresponding peak-hour total flow rate.

Figure 7B shows that average runway delays by 15-minute intervals to aircraft are as high as 107.4 minutes per aircraft. Peak hour average delays are 99.0 minutes for arrivals and 3.0 minutes for departures.

Figure 7C shows that the peak-period average delays to aircraft using the taxiways are 0.0 minutes for taxi-in and 0.4 minutes for taxi-out.

Figure 7D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 7A AVERAGE RUNWAY FLOW RATES

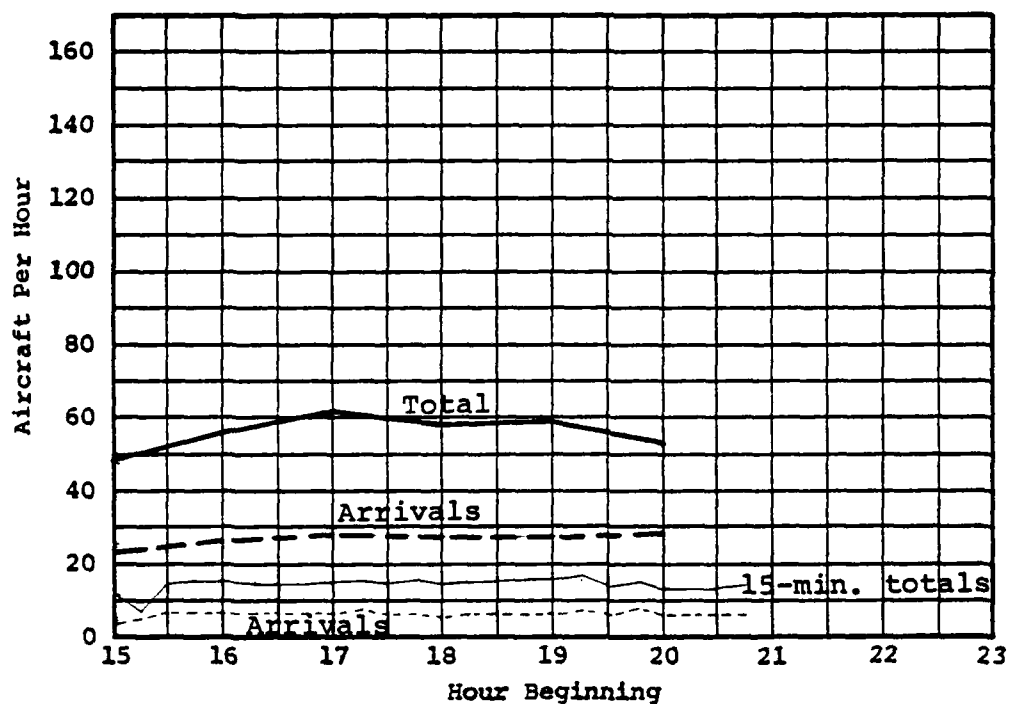


FIGURE 7B AVERAGE RUNWAY DELAYS

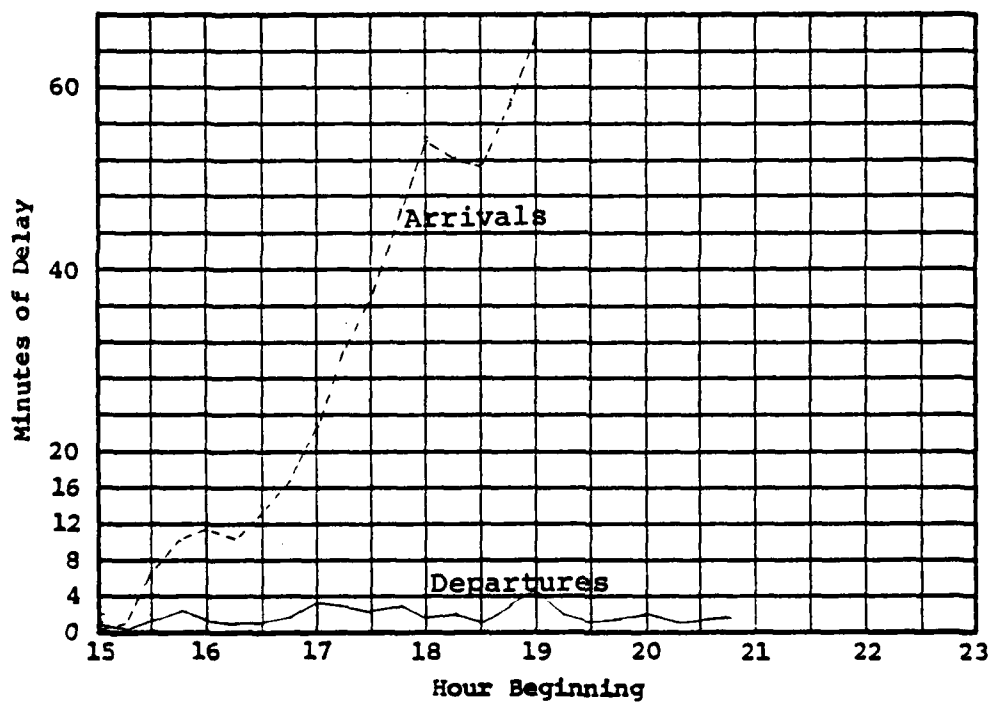


FIGURE 7C AVERAGE TAXIWAY DELAYS

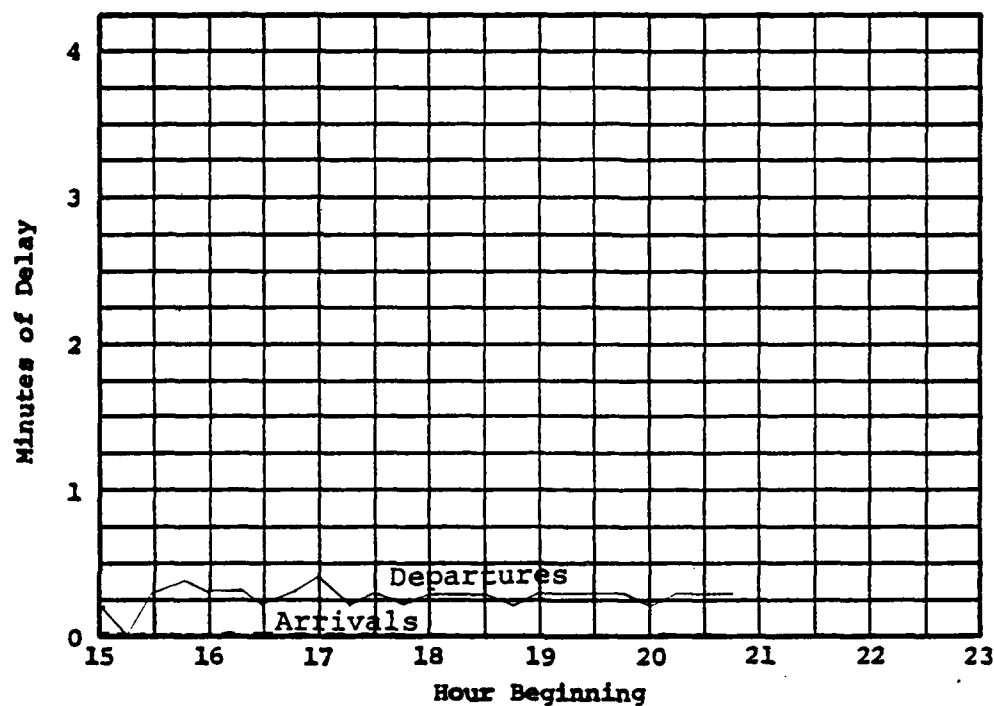
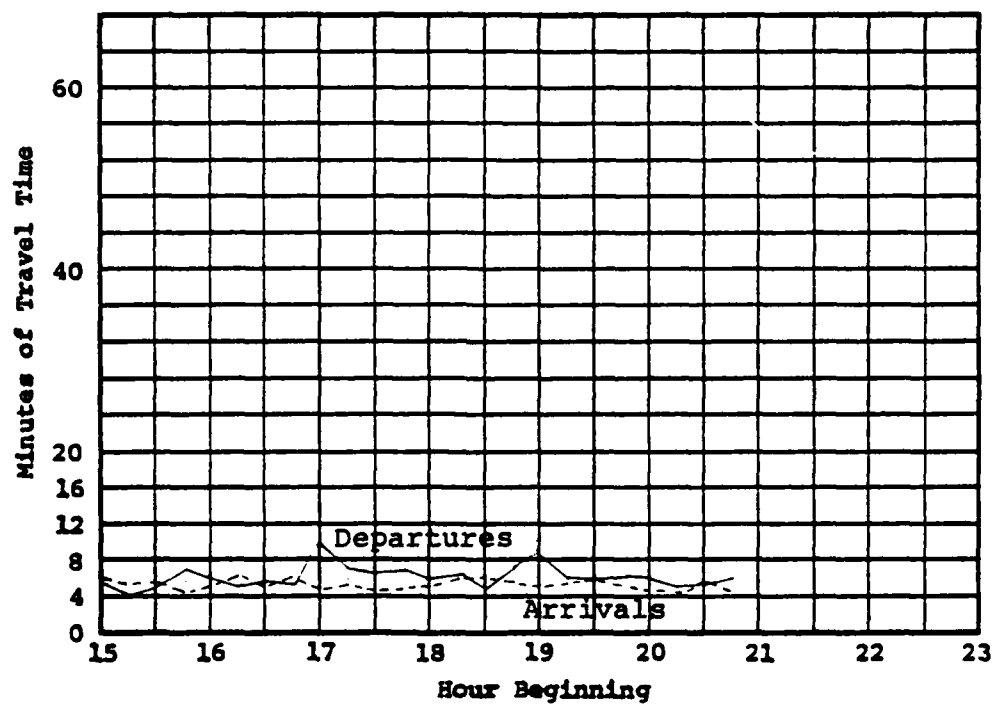


FIGURE 7D AVERAGE TAXIWAY TRAVEL TIMES



LGA - STAGE 1Experiment No. 10Objective:

To evaluate impact of relocating R13 glide slope antenna to reduce critical zone impact when there are mixed operations on R13.

Related Comparison Experiments

Experiment No. 7 serves as the comparison case for this experiment.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Anticipated Results:

Reduced delays and increased capacities due to reduction of glide slope critical-zone impact on mixed operations than in Experiment 7.

Results:

Figures 10A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment</u>		<u>Experiment No. 7</u>	
			<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	30	Many	28	20-21
Arrival	Runway Delay	min.	84.0	20:15	107.4	20:30
Arrival	Taxi-In Delay	min.	13.5	20:00	0.0	-
Departure	Flow Rate	a/c per hr.	30	20-21	33	17-18
Departure	Runway Delay	min.	39.0	20:30	3.4	17:00
Departure	Taxi-Out Delay	min.	2.7	20:15	0.4	17:00

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 10A AVERAGE RUNWAY FLOW RATES

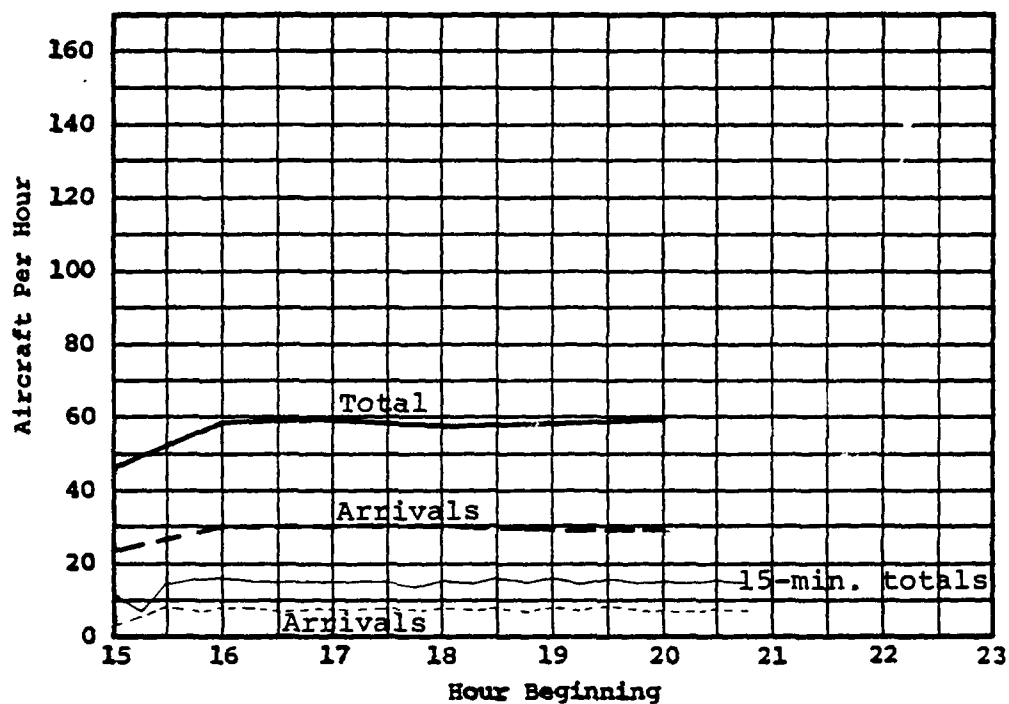


FIGURE 10B AVERAGE RUNWAY DELAYS

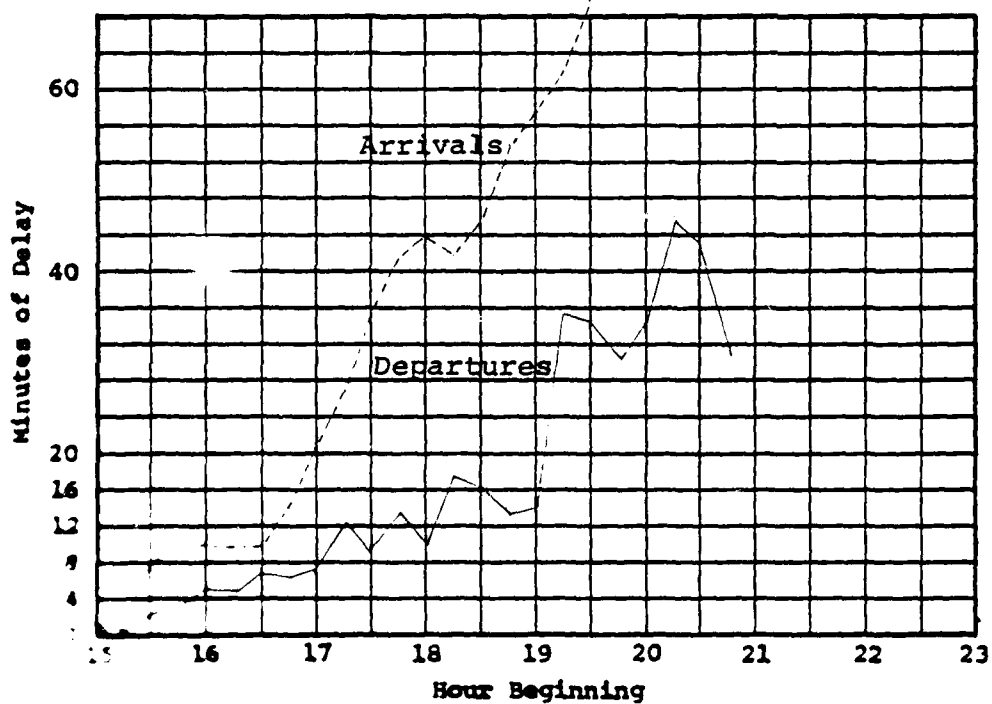


FIGURE 10C AVERAGE TAXIWAY DELAYS

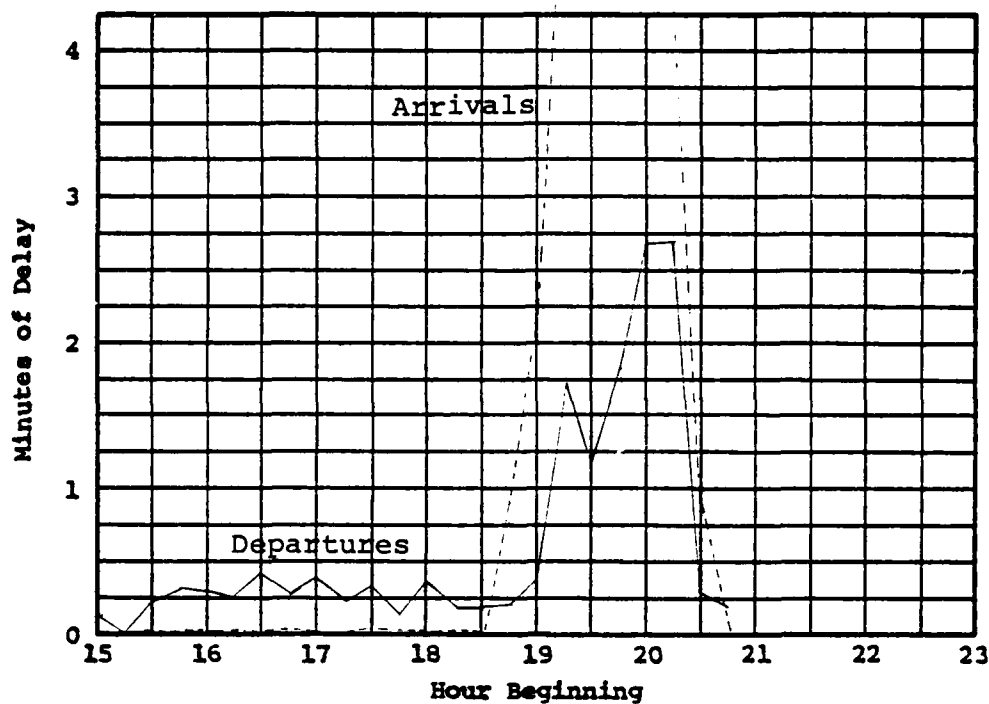
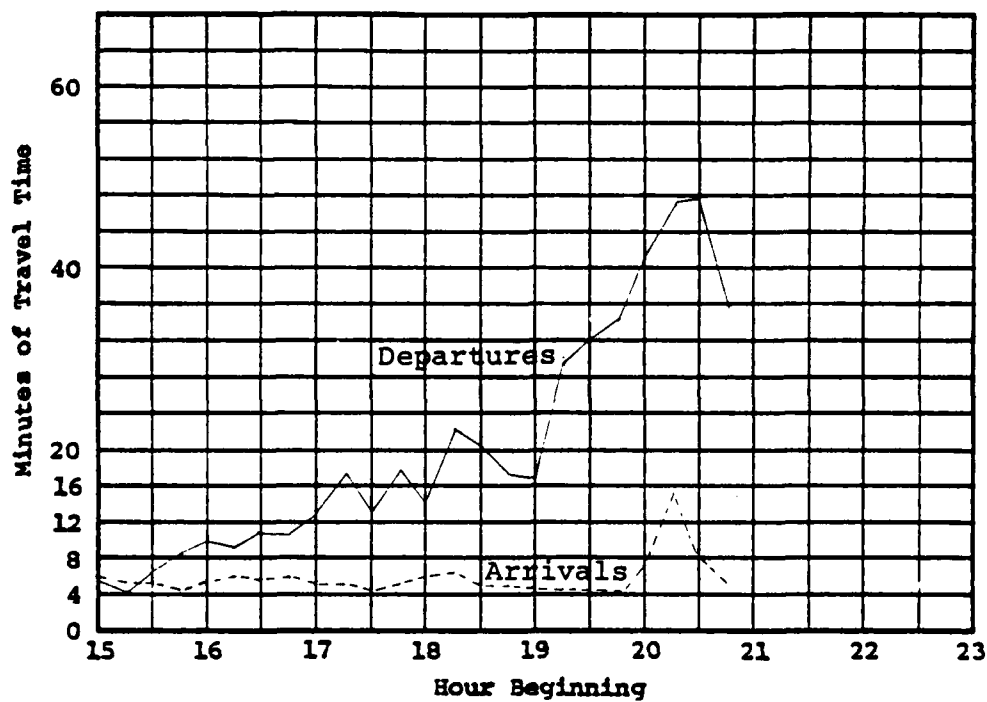


FIGURE 10D AVERAGE TAXIWAY TRAVEL TIMES



LGA - STAGE 1Experiment No. 10AObjective:

To evaluate the impact of LGA-TEB interaction on delays experienced by mixed operations on R13 in IFR1 weather conditions.

Related Comparison Experiments:

Experiment No. 7 serves as the "No-other-improvement" comparison case for this experiment. Experiment No. 10 is the comparison case if one wants to examine the limits imposed on the delay reductions of Experiment 10 by the LGA-TEB interaction.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Anticipated Results:

Much greater delays due to interaction with TEB.

Results:

Figures 10A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment Peak</u>	<u>Time</u>	<u>Experiment No. 7 Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	9	19-20	28	20-21
Arrival	Runway Delay	min.	240.6	20:30	107.4	20:30
Arrival	Taxi-In Delay	min.	0.04	17:00	0.0	-
Departure	Flow Rate	a/c per hr.	24	15-16	33	17-18
Departure	Runway Delay	min.	0.9	17:15	3.4	17:00
Departure	Taxi-Out Delay	min.	0.3	15:45	0.4	17:00

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE (10A) A AVERAGE RUNWAY FLOW RATES

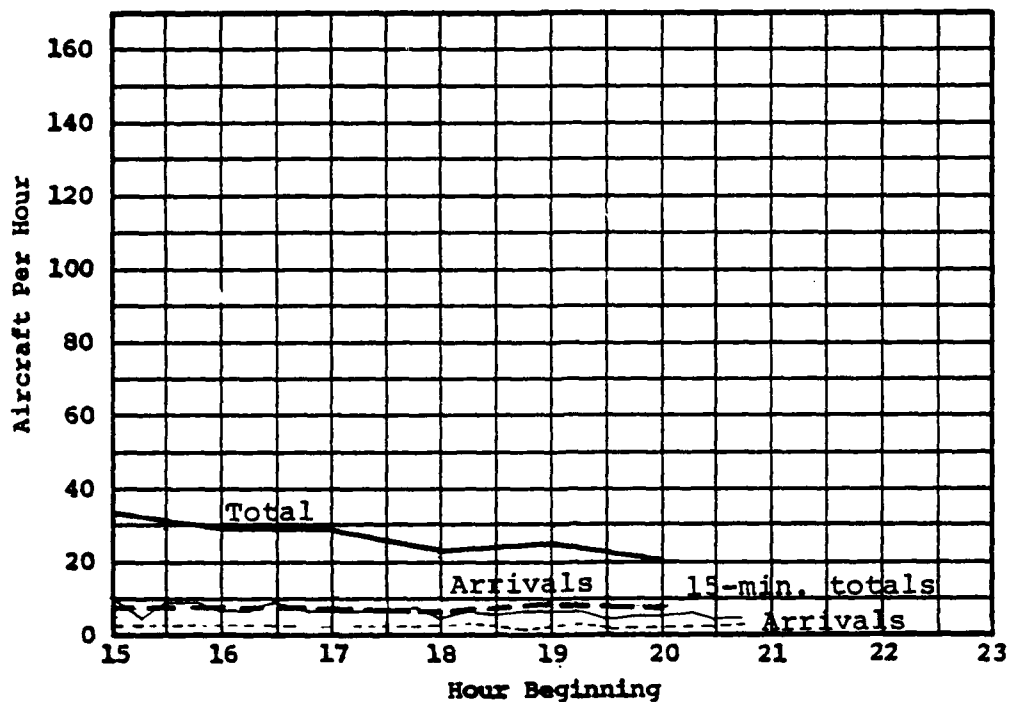


FIGURE (10A) B AVERAGE RUNWAY DELAYS

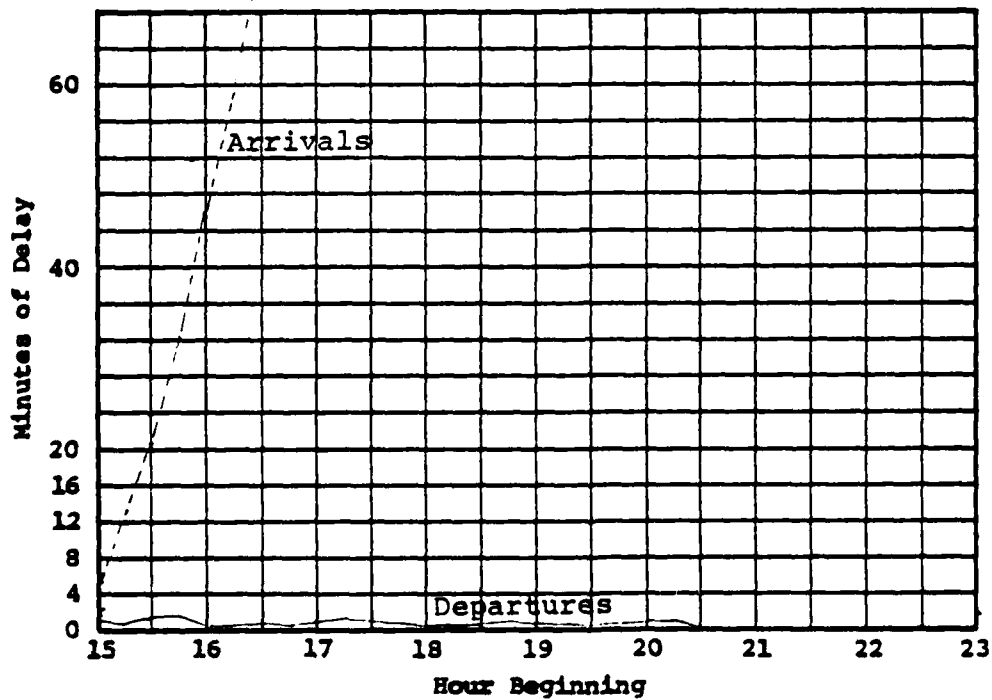


FIGURE (10A)C AVERAGE TAXIWAY DELAYS

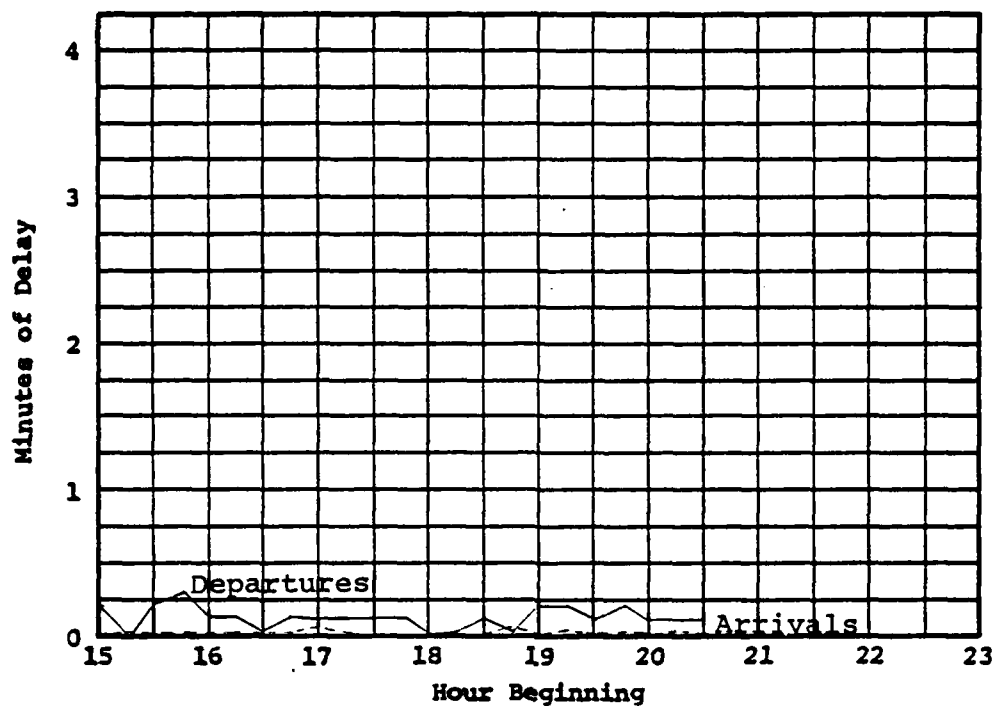
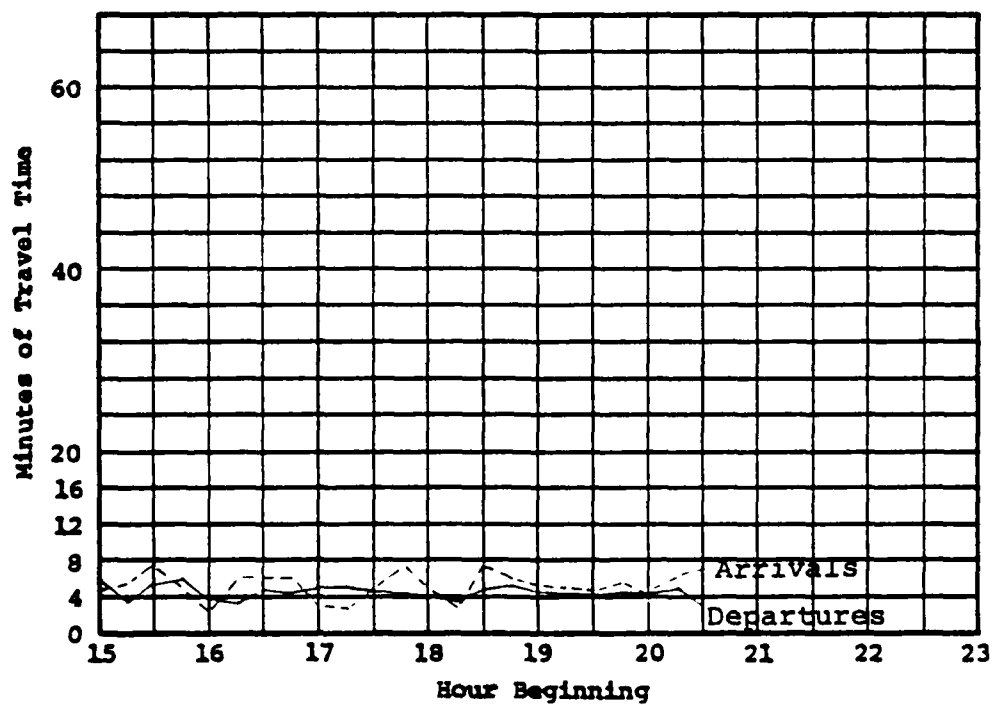


FIGURE (10A)D AVERAGE TAXIWAY TRAVEL TIMES



LGA - STAGE 1Experiment No. 8Objective:

To obtain baseline delay estimates, in IFR1 conditions, for the following runway use configuration:

<u>Arrivals</u>	<u>Departures</u>
R4	R4

Related Comparison Experiments:

Experiment No. 13 has same runway use and weather conditions as No. 8 but with an improved taxiway network for departures west of R4/22.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Results:

Figure 8A shows that total aircraft flows vary from 46 to 63 aircraft per hour over the 6-hour simulation run. The peak hour is from 19:00 to 20:00 hours and contained 29 arrivals and 34 departures. Figures 9A and 8B also show the variation of runway flow rates by 15-minute periods. Note that the peak 15-minute total flow rate is 17 aircraft per hour, which is 27 percent of the corresponding peak-hour total flow rate.

Figure 8B shows that average runway delays by 15-minute intervals to aircraft are as high as 89.2 minutes per aircraft. Peak hour average delays are 89.2 minute for arrivals and 11.3 minutes for departures.

Figure 8C shows that the peak-period average delays to aircraft using the taxiways are 0.02 minutes for taxi-in and 0.4 minutes for taxi-out.

Figure 8D shows average travel times for arrivals (threshold-to-gate times) and departures (gate-to-roll times) for each 15-minute interval simulated.

FIGURE 8A AVERAGE RUNWAY FLOW RATES

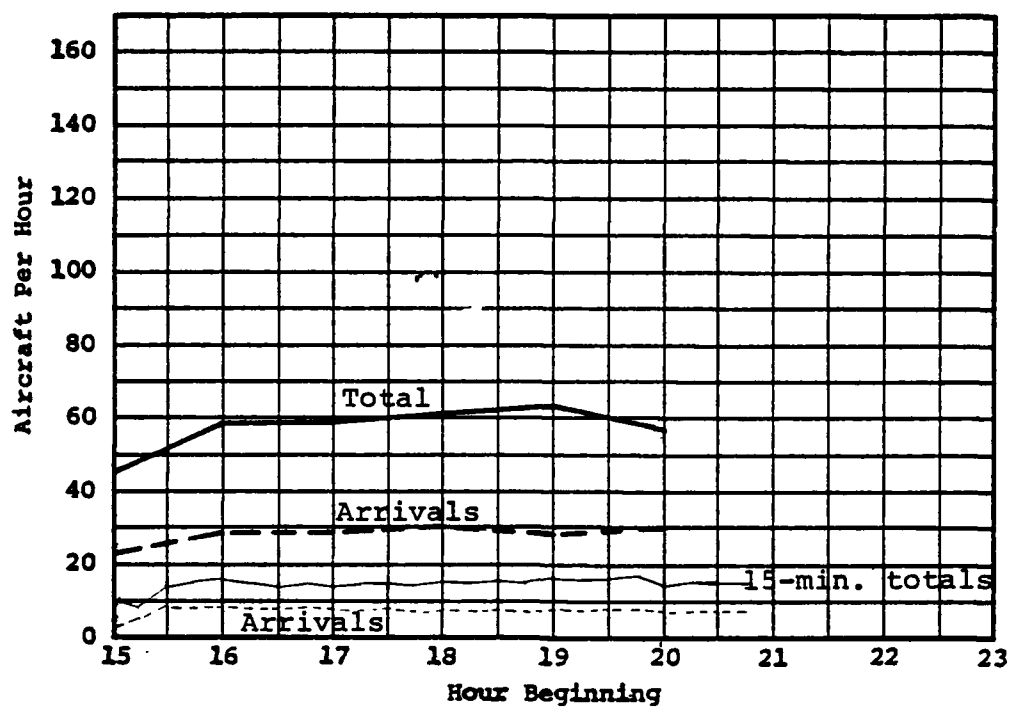


FIGURE 8B AVERAGE RUNWAY DELAYS

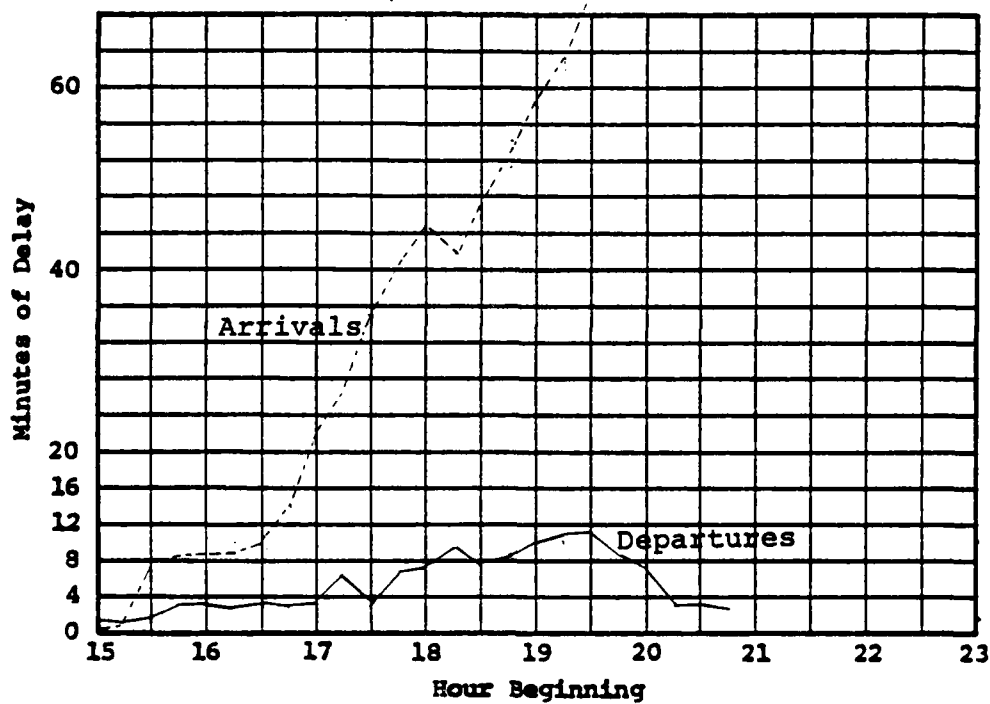


FIGURE 8C AVERAGE TAXIWAY DELAYS

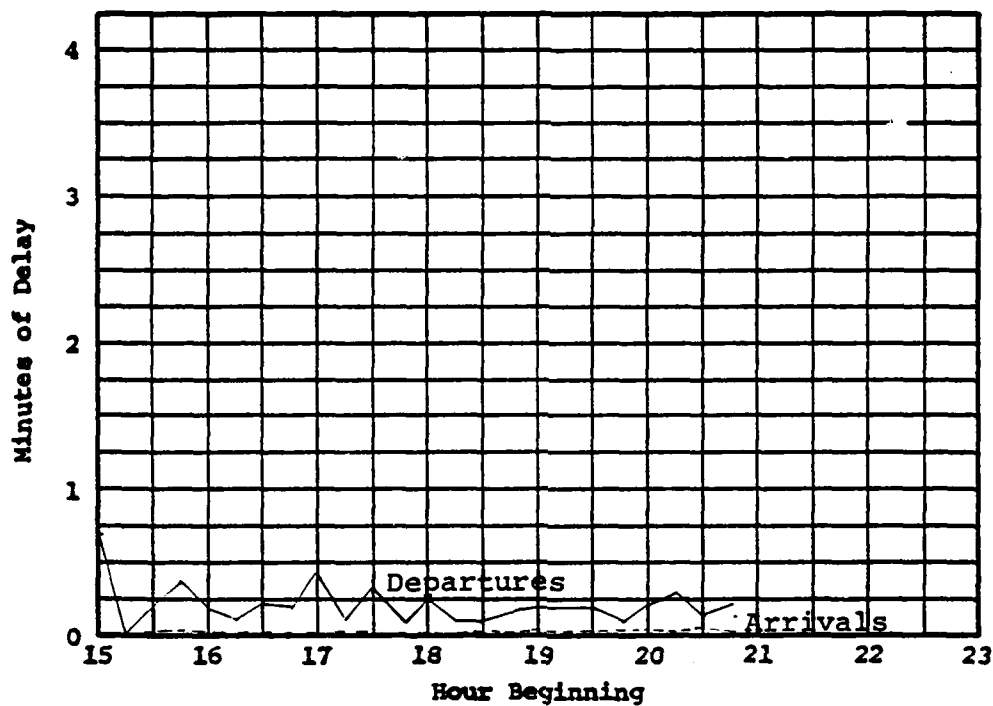
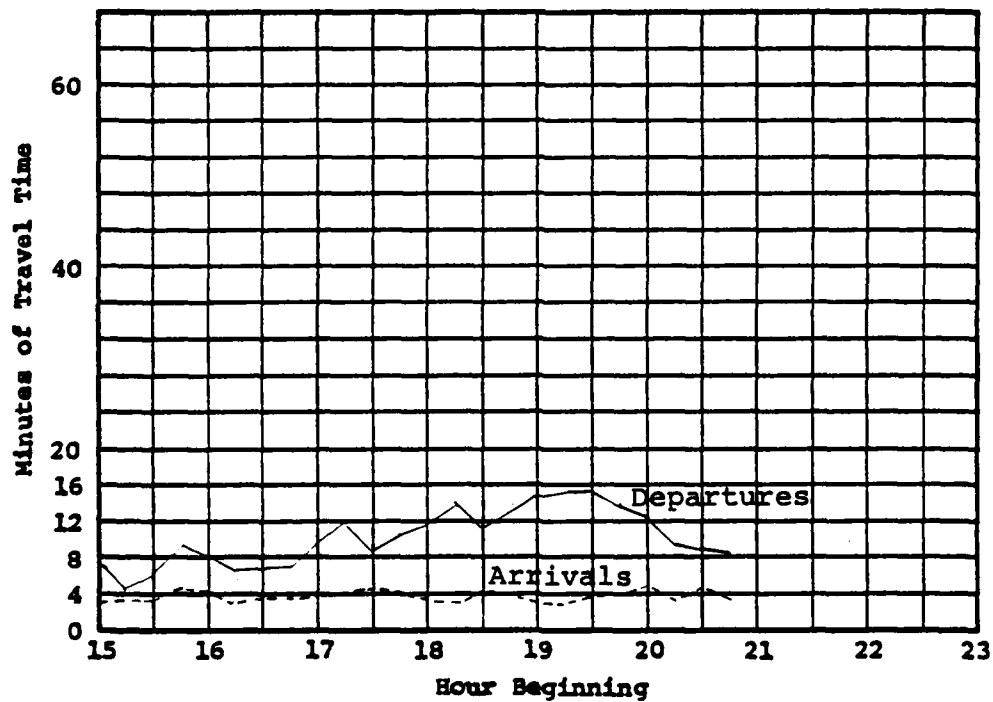


FIGURE 8D AVERAGE TAXIWAY TRAVEL TIMES



LGA - STAGE 1Experiment No. 9Objective:

To evaluate the potential delay savings of improving airspace procedures so that the flow of arrivals to R13, in IFR1 weather conditions, is independent of the flow of departures on R4.

Related Comparison Experiments:

The potential benefits of these improved airspace procedures are obtained by comparison with Experiment No. 7, arrivals and departures on R13.

Length and Level of Detail of Simulation Run:

From 15:00 to 21:00 with 15-minute summaries.

Anticipated Results:

Lower delays and greater capacities than in Experiment 7.

Results:

Figures 9A, B, C, and D show estimated flow rates, runway delays, taxi delays, and travel times, respectively.

Summary Comparison:

<u>Operation Type</u>	<u>Performance Measure*</u>	<u>Units</u>	<u>This Experiment</u>		<u>Experiment No. 7</u>	
			<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
Arrival	Flow Rate	a/c per hr.	27	Many	28	20-21
Arrival	Runway Delay	min.	114.7	20:45	107.4	20:30
Arrival	Taxi-In Delay	min.	5.6	19:15	0.0	-
Departure	Flow Rate	a/c per hr.	29	Many	33	17-18
Departure	Runway Delay	min.	24.4	19:30	3.4	17:00
Departure	Taxi-Out Delay	min.	4.2	19:00	0.4	17:00

*These are all average values over one hour (flow rates) or 15 minutes.

FIGURE 9A AVERAGE RUNWAY FLOW RATES

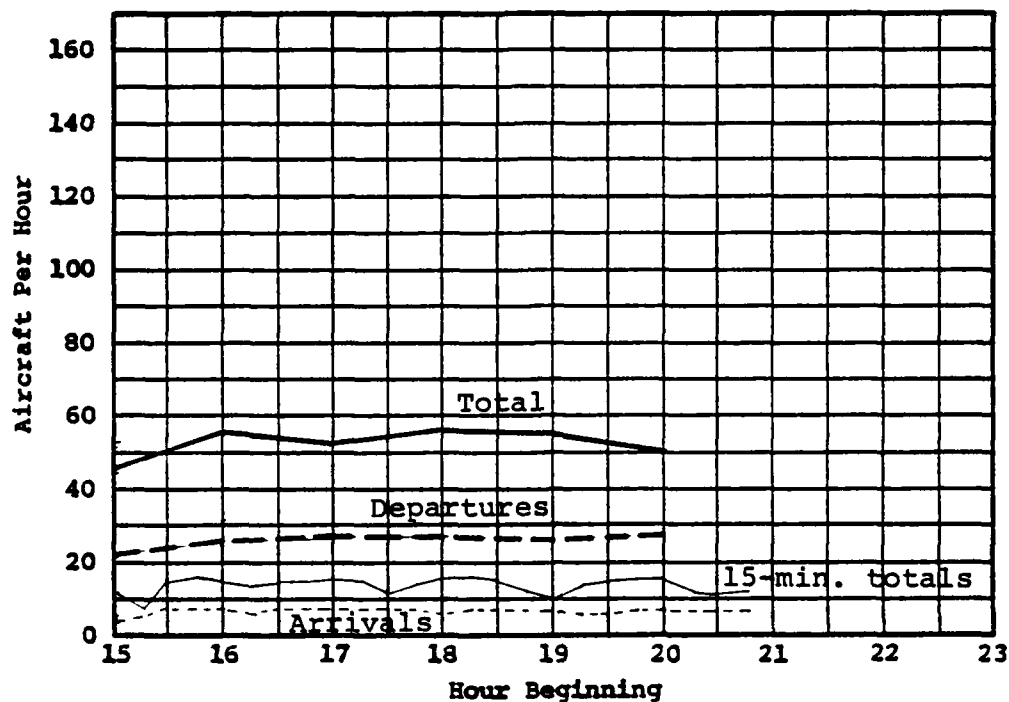


FIGURE 9B AVERAGE RUNWAY DELAYS

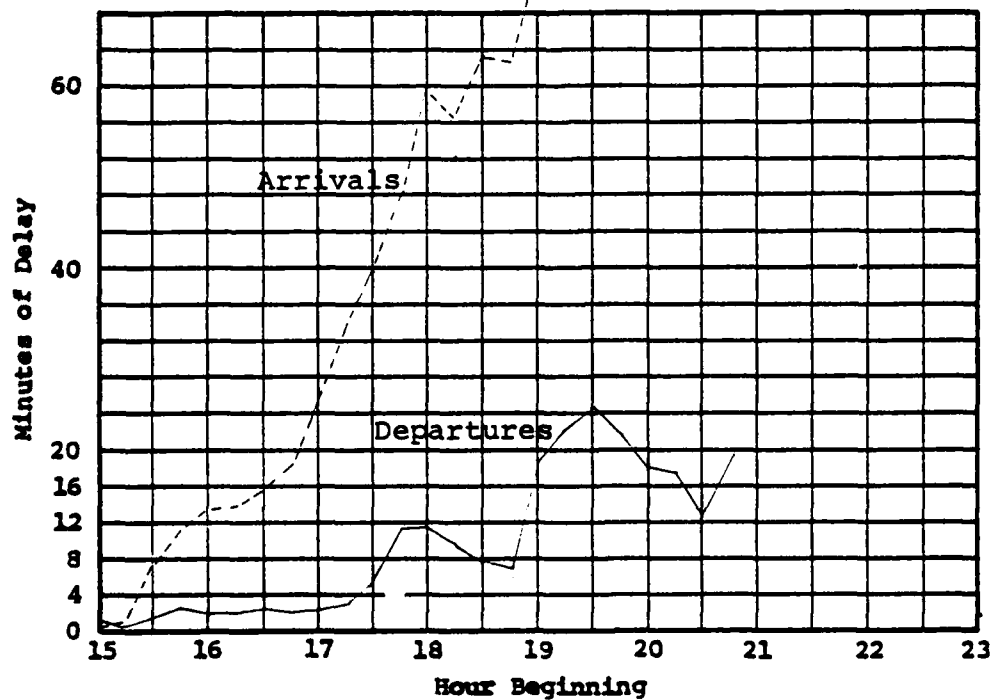


FIGURE 9C AVERAGE TAXIWAY DELAYS

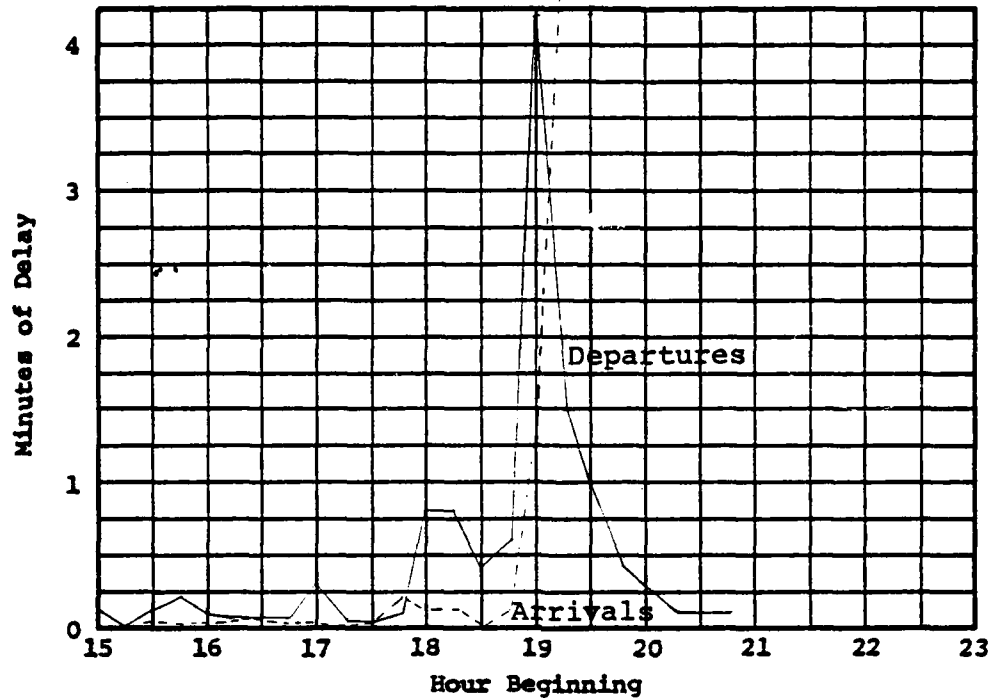
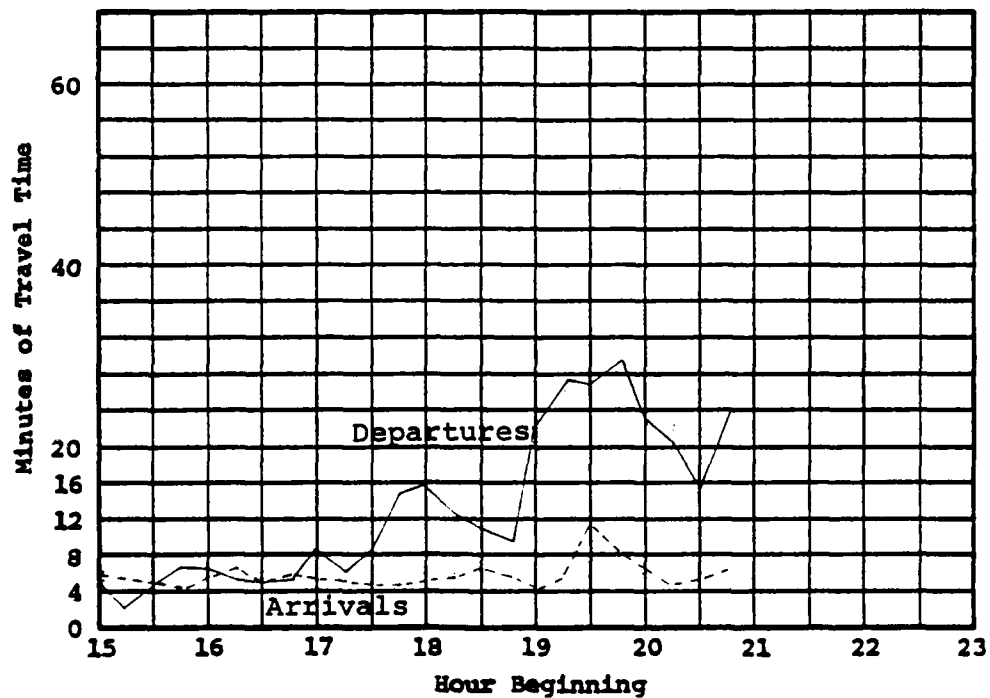


FIGURE 9D AVERAGE TAXIWAY TRAVEL TIMES



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